भारतीय मानक
Indian Standard

IS 808 : 2021

(Amalgamating IS 12778 : 2004)

तप्त बेलित इस्पात बीम, कॉलम, चैनल और कोण अनुभाग — आयाम और गुण

(चौथा पुनरीक्षण)

Hot Rolled Steel Beam, Column, Channel and Angle Sections — Dimensions and Properties

(Fourth Revision)

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Structural Engineering and Structural Sections Sectional Committee, CED 07

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Structural Engineering and Structural Sections Sectional Committee had been approved by the Civil Engineering Division Council.

Under the steel economy programme, a rational, efficient and economical series of Indian Standards on beam sections, channel sections and angle sections was evolved in 1957 and IS 808 was published in 1957 covering junior, light weight, medium weight, wide flange and heavy weight beam sections, junior, light weight and medium weight channel sections and equal and unequal leg angle sections. This standard was revised in 1964.

In the second revision of this standard, parts relating to medium weight beam sections – MB series, column sections – SC series, channel sections – MC and MCP series and equal and unequal leg angles were revised and published as Parts 1, 2, 3, 4, 5 and 6 of IS 808, respectively. In the third revision in 1989, the Committee felt it convenient to merge all the five parts into one standard.

In this revision, the Committee felt it appropriate to merge IS 12778 : 2004 'Hot rolled parallel flange steel sections for beams, columns and bearing piles — Dimensions and section properties'. Both these standards deal with the dimension and sectional properties for hot rolled sloping and/or parallel flange sections and widely used by the designers. The merger will facilitate better access of the sectional details under one resource document. The following additional modifications have been effected in this revision:

a) The coordinate axes of the cross-section have been changed in alignment with IS 800.

b) Plastic section modulus has been presented for all structural sections.

c) The torsional cross-sectional properties, St. Venant's constant, I_t and warping constant, I_w have been presented.

d) Formulae for the calculation of sectional properties are included in Annex A and Annex B.

The composition of the Committee responsible for formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

HOT ROLLED STEEL BEAM, COLUMN, CHANNEL AND ANGLE SECTIONS — DIMENSIONS AND PROPERTIES

(Fourth Revision)

1 SCOPE

This standard covers the nominal dimensions, mass and sectional properties of hot rolled sloping and parallel flange beam and column sections, sloping and parallel flange channel sections, equal and unequal leg angle sections, and parallel flange bearing piles.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1852 : 1985	Rolling and cutting tolerances for hot rolled steel products (*fourth revision*)
2062 : 2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
12779 : 1989	Rolling and cutting tolerances for hot rolled parallel flange beam and column sections

3 CONVENTIONS FOR MEMBER AXES

Unless otherwise specified convention used for member axes is as follows (*see* Fig. 1):

3.1 *X-X* Axis — A line along the member passing through the centre of gravity of the sections profile.

3.2 *Y-Y* Axis — A line perpendicular to the flanges (in case of beams and channels) or perpendicular to the smaller leg (in case of an angle section) and passing through the centre of gravity of the sections profile.

3.3 *Z-Z* Axis — A line parallel to the flanges (in case of beams and channels) or parallel to the smaller leg (in case of an angle section) and passing through the centre of gravity of the sections profile.

3.4 *U-U* and *V-V* Axes — Lines passing through the centre of gravity of the sections profile, representing the principal axes of angle sections, where *U-U* is a major axis (when it does not coincide with *z-z* axis)

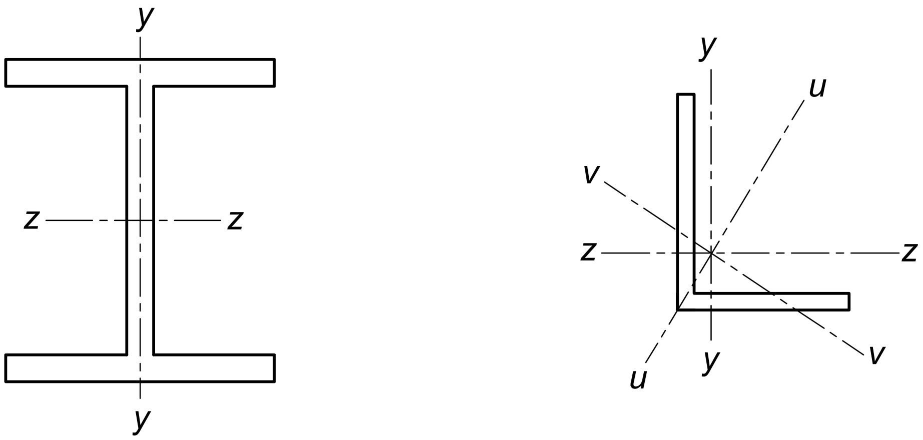


FIG. 1 AXES OF MEMBERS

and *V-V* axis is a minor axis (when it does not coincide with *y-y* axis).

4 SYMBOLS

4.1 Letter symbols used in this standard have been indicated appropriately in Table 1 to 13. More explicit definitions for certain symbols, used in the figures and tables are given in **4.1.1** and **4.1.2**.

4.1.1 *Symbols for Dimensions*

a, b	–	Longer and shorter leg length of angle section, respectively
B	–	Flange width of beam, column or channel sections
D	–	Depth of beam, column or channel section
R_1 or R	–	Radius at fillet or root
R_2	–	Radius at toe
t	–	Thickness of web of beam, column or channel section; thickness of leg of angle, section
T	–	Thickness of flange of beam, column or channel section

4.1.2 *Symbols for Sectional Properties and Mass*

A	–	Sectional area
C (with subscripts z, y, u or v)	–	Distance of centre of gravity,
C_z	–	a-e$_z$
C_y	–	b-e_y
e_z	–	Distance of extreme fibre from *Z-Z* axis
e_y	–	Distance of extreme fibre from *Y-Y* axis
I_z	–	Moment of inertia about *Z-Z* axis
I_y	–	Moment of inertia about *Y-Y* axis
I_u	–	Moment of inertia (Max) about *U-U* axis
I_v	–	Moment of inertia (Min) about *V-V* axis
M	–	Mass of the section per meter length
$Z_z = \frac{I_z}{e_z}$	–	Modulus of section about *Z-Z* axis
$Z_y = \frac{I_y}{e_y}$	–	Modulus of section about *Y-Y* axis
Z_{Pz}	–	Plastic section modulus about *Z-Z* axis
Z_{Py}	–	Plastic section modulus about *Y-Y* axis
$r_z = \sqrt{\frac{I_z}{A}}$	–	Radius of gyration about *Z-Z* axis
$r_y = \sqrt{\frac{I_y}{A}}$	–	Radius of gyration about *Y-Y* axis
$r_u = \sqrt{\frac{I_u}{A}}$	–	Radius of gyration about *U-U* axis
$r_v = \sqrt{\frac{I_v}{A}}$	–	Radius of gyration about *V-V* axis
α	–	Angle between *U-U* and *Z-Z* axis of angle section; slope of flange in the case of beam, column or channel

5 CLASSIFICATIONS

5.1 Beam, column, channel, angle and piles bearing sections are classified as follows.

5.1.1 *Beams*

a) Indian standard junior beams (ISJB);
b) Indian standard light weight beams (ISLB);
c) Indian standard medium weight beams (ISMB);
d) Indian standard wide flange beams (ISWB);
e) Indian standard narrow parallel flange beams (ISNPB); and
f) Indian standard wide parallel flange beams (ISWPB).

5.1.2 *Columns/Heavy Weight Beams*

a) Indian standard column sections (ISSC); and
b) Indian standard heavy weight beam (ISHB).

5.1.3 *Channels*

a) Indian standard junior channels (ISJC);
b) Indian standard light weight channels (ISLC);
c) Indian standard medium weight channels (ISMC); and
d) Indian Standard medium weight parallel flange channels (ISMPC).

5.1.4 *Angles*

a) Indian standard equal leg angles (ISA); and
b) Indian standard unequal leg angles (ISA).

5.1.5 *Bearing Piles*

a) Indian standard parallel flange bearing piles (ISPBP).

5.2 The following abbreviated reference symbols have been used in designating the Indian Standard sections mentioned in **5.1**:

Sl No. (1)	*Section* (2)	*Classification* (3)	*Abbreviated Reference Symbol* (4)
i)	Beams	ISJB	JB
		ISLB	LB
		ISMB	MB
		ISWB	WB
		ISNPB	NPB
		ISWPB	WPB
ii)	Columns/heavy beams sections	ISSC	SC
		ISHB	HB
iii)	Channels	ISJC	JC
		ISLC	LC
		ISMC	MC
		ISMPC	MPC
iv)	Angles	ISA	∠
v)	Pile sections	ISPBP	PBP

6 DESIGNATION

6.1 Beam, columns and channel sections shall be designated by the respective abbreviated reference symbols followed by the depth of the section, for example:

a) *MB* 200 — For a medium weight beam of depth 200 mm,

b) *SC* 200 — For a column section of depth 200 mm,

c) *MC* 200 — For medium weight channel of depth 200 mm, and

d) *MPC* 200 — For a medium weight parallel flange channel of depth 200 mm, and

6.2 Narrow parallel flange beams are doubly symmetric shapes, generally used as beams whose inside flange surfaces are substantially parallel. Beams under this standard have flange widths generally lower than the depth. Beams are manufactured with heavy, medium and light flange and web thickness. Beams shall be designated by nominal depth and nominal flange width and mass of the section in kg/m. For example, NPB 300 × 150 × 36.52 would mean narrow parallel flange beam having nominal beam depth of 300 mm, nominal flange width of 150 mm and beam mass of 36.52 kg/m.

6.3 Wide parallel flange beams are doubly symmetric shapes, generally used as beams or columns whose inside flange surfaces are substantially parallel. Beams or columns under the standard have nominal flange width same as depth up to nominal beam depth 300 mm. Beam depth larger than 300 mm have nominal flange width from 300 to 400 mm. Columns may have flange widths more than the depths. Beams and column section are manufactured with heavy, medium and light flange and web thickness. Beams and columns are designated by nominal depth and nominal flange width and mass in kg/m. For example, WPB 600 × 300 × 128.79 would mean wide parallel flange beam having nominal depth 600 mm nominal flange width of 300 mm and beam mass of 128.79 kg/m, and WPB 360 × 370 × 136.20 would mean wide parallel flange columns having nominal depth of 360 mm and nominal flange width of 370 mm and a mass of 136.20 kg/m.

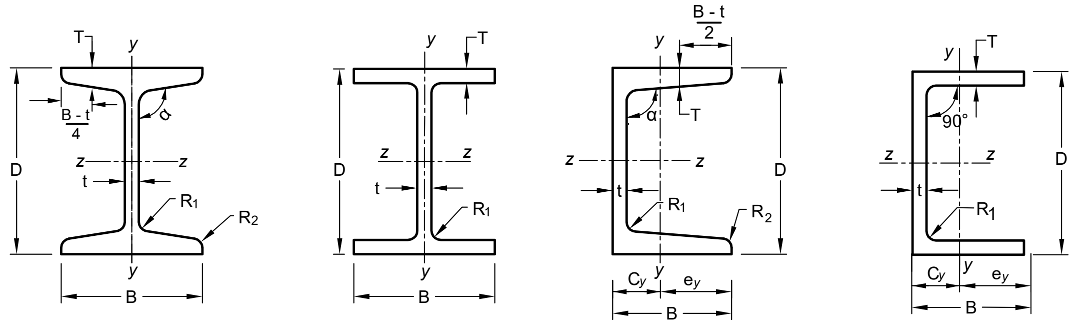
6.4 Equal and unequal leg angles shall be designated by the abbreviated reference symbol (∠) followed by the dimensions *A*, *B* and *t*. For example, ∠ 200 × 100 × 10 represents unequal leg angle of dimensions of legs 200 mm and 100 mm and thickness 10 mm.

6.5 Parallel flange bearing pile sections are doubly symmetric wide flange shapes generally used as bearing piles whose flanges and webs are of same nominal thickness and whose depth and width are essentially the same. Bearing piles are generally designated by nominal depth of the section and mass in kg/m. For example, PBP 360 × 174.02 would mean bearing pile section having nominal depth of 360 mm and nominal flange width of 360 mm and mass of 174.02 kg/m.

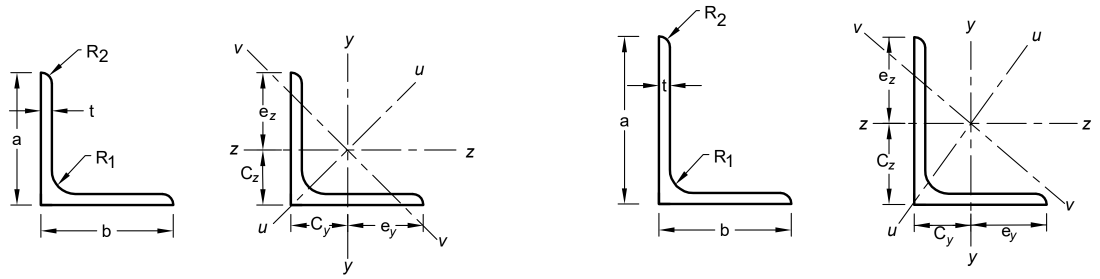
7 DIMENSIONS, MASS AND TOLERANCES

7.1 Nominal dimensions and mass of several sections shall conform to the values given in respective tables and fgigures as follows:

Sl No. (1)	*Sections* (2)	*Table No.* (3)	*Figure No.* (4)
i)	Sloping flange beams	1 and 2	Fig. 2a
ii)	Parallel flange beams	3 and 4	Fig. 2b
iii)	Heavy beam/column section	5	Fig. 2a
iv)	Sloping flange channel	6 and 7	Fig. 2c
v)	Parallel flange channel	8	Fig. 2d
vi)	Equal leg angle	9 and 10	Fig. 2e
vii)	Unequal leg angle	11 and 12	Fig. 2f
viii)	Bearing piles	13	Fig. 2b



a) SLOPING FLANGE BEAM b) PARALLEL FLANGE BEAM c) SLOPING FLANGE CHANNEL d) PARALLEL FLANGE CHANNEL



e) EQUAL LEG ANGLES f) UNEQUAL LEG ANGLES

Fig. 2 Dimensions of the Sections

7.2 Dimensional and mass tolerances of the various sections shall conform to the appropriate values stipulated in IS 1852 and IS 12779.

8 STEEL GRADES

Material strength of steel sections shall be conforming to IS 2062.

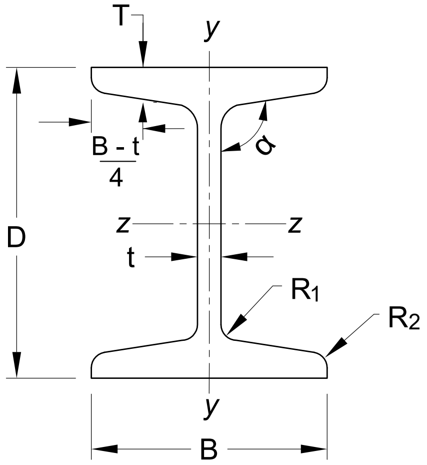
9 SECTIONAL PROPERTIES

9.1 Sectional properties of the beams, columns, channels, equal and unequal leg angles and bearing piles shall be as given in Tables 1 to 13.

9.2 With advancements in steel rolling and technologies, steel mills can produce wide range of structural steel sections. The customization of sizes through optimum flange width, beam depth, thicknesses of flange and web will enable cost savings on the overall steel take off in addition to the reliability of connections achieved. A new range of sections suiting to the need of the design requirements can be produced based on the formulae to calculate the geometrical sectional properties as per Annex A and Annex B that fulfils the design criteria.

Table 1 I-Section Beams : Nominal Dimensions, Mass and Sectional Properties of Indian Standard Medium and Wide Flange Beams

(*Clauses* 4.1, 7.1 *and* 9.1)



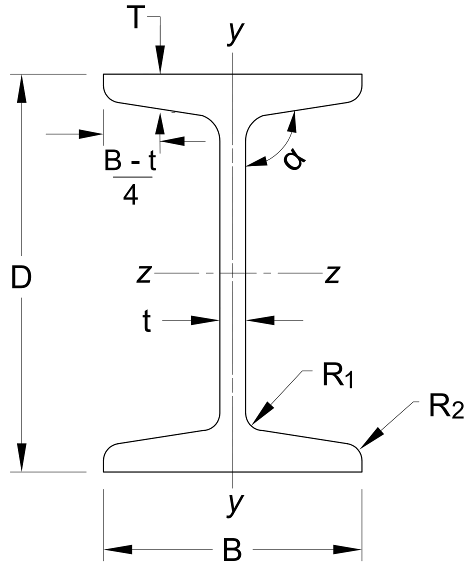
Designation	***Mass,***	**Area,**	**Dimensions**							**Properties**									
	M	*A*	*D*	*B*	*t*	*T*	Flange Slope (α)	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degrees	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Medium Flange Beams																			
MB 100	8.95	11.4	100	50	4.7	7.0	98.0	9.0	4.5	182	12.5	39.9	10.4	36.4	5.01	42.6	8.58	2.15	315
MB 125	13.35	17.0	125	70	5.0	8.0	98.0	9.0	4.5	445	38.4	51.1	15.0	71.3	10.9	82.1	18.4	3.99	1 560
MB 150	14.96	19.0	150	75	5.0	8.0	98.0	9.0	4.5	718	46.7	61.3	15.6	95.7	12.4	109	21.0	4.36	2 830
MB 175	19.50	24.8	175	85	5.8	9.0	98.0	10.0	5.0	1 260	76.6	71.2	17.5	144	18.0	165	30.5	7.17	6 340
MB 200	24.17	30.8	200	100	5.7	10.0	98.0	11.0	5.5	2 110	136	82.8	21.0	211	27.3	240	46.0	10.7	15 000
MB 225	31.15	39.7	225	110	6.5	11.8	98.0	12.0	6.0	3 440	218	93.1	23.4	306	39.6	348	66.3	18.6	29 700
MB 250	37.30	47.5	250	125	6.9	12.5	98.0	13.0	6.5	5 130	334	103	26.5	410	53.5	465	89.7	25.5	57 300
MB 300	46.02	58.6	300	140	7.7	13.1	98.0	14.0	7.0	8 990	486	123	28.7	599	69.4	681	117	34.7	123 000
MB 350	52.33	66.7	350	140	8.1	14.2	98.0	14.0	7.0	13 600	537	142	28.3	779	76.8	889	129	43.1	183 000

Table 1 (*Concluded*)

Designation	***Mass,*** *M*	**Area,** *A*	**Dimensions**							**Properties**									
			D	B	t	T	Flange Slope (α)	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degrees	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
MB 400	61.55	78.4	400	140	8.9	16.0	98.0	14.0	7.0	20 400	622	161	28.1	1 020	88.8	1 170	149	59.6	269 000
MB 450	72.38	92.2	450	150	9.4	17.4	98.0	15.0	7.5	30 400	834	181	30.0	1 350	111	1 550	187	81.0	457 000
MB 500	86.88	110	500	180	10.2	17.2	98.0	17.0	8.5	45 200	1 360	202	35.1	1 800	152	2 070	259	103	974 000
MB 550	103.64	132	550	190	11.2	19.3	98.0	18.0	9.0	64 900	1 830	221	37.2	2 360	193	2 710	328	150	1 550 000
MB 600	121.00	154	600	210	12.0	20.3	98.0	20.0	10.0	90 200	2 570	241	40.8	3 000	245	3 450	418	198	2 630 000
Wide Flange Beams																			
WB 150	17.00	21.6	150	100	5.4	7.0	96.0	8.0	4.0	839	94.7	6.22	2.09	111	18.9	126	31.9	4.22	5 960
WB 175	22.06	28.1	175	125	5.8	7.4	96.0	8.0	4.0	1 510	188	7.32	2.59	172	30.1	194	51.2	6.22	16 900
WB 200	28.80	36.7	200	140	6.1	9.0	96.0	9.0	4.5	2 620	328	8.45	2.99	262	46.9	294	78.7	11.3	37 500
WB 200	52.09	66.4	203	152	8.9	16.5	98.0	15.5	7.6	4 780	809	8.48	3.49	470	106	539	175	65.8	83 900
WB 225	33.93	43.2	225	150	6.4	9.9	96.0	9.0	4.5	3 920	448	9.52	3.22	348	59.8	389	99.7	15.5	64 400
WB 250	40.84	52.0	250	200	6.7	9.0	96.0	10.0	5.0	5 940	857	10.6	4.05	475	85.7	527	149	17.8	174 000
WB 300	48.12	61.3	300	200	7.4	10.0	96.0	11.0	5.5	9 820	990	12.6	4.01	654	99.0	731	171	24.7	280 000
WB 350	56.89	72.4	350	200	8.0	11.4	96.0	12.0	6.0	15 500	1 170	14.6	4.02	887	117	995	200	35.6	435 000
WB 400	66.71	85.0	400	200	8.6	13.0	96.0	13.0	6.5	23 400	1 380	16.6	4.04	1 170	138	1 320	234	50.6	648 000
WB 450	79.52	101	450	200	9.2	15.4	96.0	15.0	7.0	35 100	1 700	18.6	4.10	1 560	170	1 760	284	78.7	969 000
WB 500	95.12	121	500	250	9.9	14.7	96.0	15.0	7.5	52 200	2 980	20.7	4.96	2 090	239	2 350	406	94.3	2 250 000
WB 550	112.48	143	550	250	10.5	17.6	96.0	16.0	8.0	74 900	3 740	22.8	5.10	2 720	299	3 060	500	145	3 240 000
WB 600	133.70	170	600	250	11.2	21.3	96.0	17.0	8.5	106 000	4 700	24.9	5.25	3 540	376	3 980	619	234	4 640 000
WB 600	145.06	184	600	250	11.8	23.6	96.0	18.0	9.0	115 000	5 290	25.0	5.35	3 850	423	4 340	692	305	5 100 000

Table 2 Nominal Dimensions, Mass and Sectional Properties of Indian Standard Junior and Light Weight Beams

(*Clauses* 4.1, 7.1 *and* 9.1)



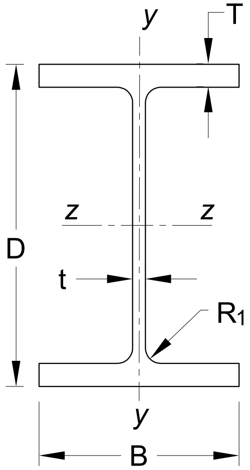
Designation	Mass,	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope (α)	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degrees	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Junior Beams																			
JB 150	7.07	9.00	150	50	3.0	4.6	91.5	5.0	1.5	321	9.21	59.7	10.1	42.8	3.68	49.5	5.96	0.548	506
JB 175	8.07	10.2	175	50	3.2	4.8	91.5	5.0	1.5	480	9.65	68.3	09.69	54.9	3.86	64.2	6.32	0.656	724
JB 200	9.92	12.6	200	60	3.4	5.0	91.5	5.0	1.5	780	17.2	78.5	11.6	78.0	5.76	90.9	9.35	0.873	1 710
JB 225	12.78	16.2	225	80	3.7	5.0	91.5	6.5	1.5	1 310	40.4	89.7	15.7	116	10.1	134	16.2	1.27	5 160
Light Weight Beams																			
LB 75	6.05	7.71	75	50	3.7	5.0	91.5	6.5	2.0	72.7	10.0	30.7	11.3	19.3	4.00	22.3	6.39	0.737	127
LB 100	8.01	10.2	100	50	4.0	6.4	91.5	7.0	3.0	168	12.7	40.5	11.1	33.6	5.08	38.9	8.20	1.38	292

Table 2 (*Concluded*)

Designation	**Mass,** M	**Area** A	**Dimensions**							**Properties**									
			D	B	t	T	Flange Slope (α)	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degrees	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
LB(P) 100	8.75	11.1	100	50	4.3	7.0	91.5	8.0	3.0	181	14.0	40.4	11.2	36.3	5.60	42.3	9.06	1.86	315
LB 125	11.87	15.1	125	75	4.4	6.5	91.5	8.0	3.0	406	43.3	51.8	16.9	65.1	11.5	73.9	18.3	2.21	1 600
LB 150	14.19	18.0	150	80	4.8	6.8	91.5	9.5	3.0	687	55.2	61.6	17.4	91.7	13.8	104	22.1	3.02	2 970
LB 175	16.59	21.1	175	90	5.0	6.9	91.5	9.5	3.0	1 090	79.5	71.8	19.4	124	17.6	141	28.2	3.55	5 920
LB(P) 175	16.60	21.1	175	80	5.2	7.7	96.0	9.5	3.0	1 060	57.2	71.0	16.4	122	14.3	140	23.9	4.50	4 590
LB 200	19.83	25.2	200	100	5.4	7.3	91.5	9.5	3.0	1 690	115	81.9	21.3	169	23.0	192	36.9	4.61	11 200
LB(P) 200	21.06	26.8	200	100	5.6	8.0	96.0	9.5	3.0	1 800	112	81.9	20.5	180	22.5	205	37.7	6.27	12 200
LB 225	23.47	29.9	225	100	5.8	8.6	98.0	12.0	6.0	2 500	112	91.4	19.4	222	22.5	254	39.2	8.47	16 700
LB 250	27.87	35.5	250	125	6.1	8.2	98.0	13.0	6.5	3 720	193	102	23.3	297	30.9	338	55.3	10.2	39 000
LB 275	32.96	42.0	275	140	6.4	8.8	98.0	14.0	7.0	5 370	287	113	26.1	391	41.0	443	73.5	14.0	71 200
LB 300	37.72	48.0	300	150	6.7	9.4	98.0	15.0	7.5	7 340	376	123	27.9	489	50.1	554	89.9	18.1	111 000
LB(P) 300	41.50	52.8	300	140	7.0	11.6	98.0	15.0	7.5	8 140	414	124	27.9	542	59.2	614	101	26.3	110 000
LB 325	43.07	54.8	325	165	7.0	9.8	98.0	16.0	8.0	9 880	510	134	30.5	608	61.9	688	111	22.8	182 000
LB 350	49.44	63.0	350	165	7.4	11.4	98.0	16.0	8.0	13 100	632	144	31.6	752	76.6	851	134	32.3	244 000
LB 400	56.82	72.4	400	165	8.0	12.5	98.0	16.0	8.0	19 300	716	16.3	3.14	965	86.8	1 090	151	41.2	351 000
LB 450	65.22	83.1	450	170	8.6	13.4	98.0	16.0	8.0	27 500	853	18.2	3.20	1 220	100	1 400	174	51.8	522 000
LB 500	74.92	95.4	500	180	9.2	14.1	98.0	17.0	8.5	38 500	1 060	20.1	3.33	1 540	118	1 770	206	65.5	808 000
LB 550	86.28	109	550	190	9.9	15.0	98.0	18.0	9.0	53 100	1 330	21.9	3.48	1 930	140	2 220	246	84.5	1 220 000
LB 600	99.39	126	600	210	10.5	15.5	98.0	20.0	10.0	72 900	1 820	23.9	3.79	2 430	173	2 790	306	107	2 04 0000

Table 3 Indian Standard Narrow Parallel Flange Beams

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	***Mass,***	**Area**	**Dimensions**							**Properties**									
	M	*A*	*D*	*B*	*t*	*T*	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_x	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times10^4$ mm^4	$\times10^4$ mm^4	mm	mm	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^4$ mm^4	$\times10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
NPB 100 X 55 X	8.10	10.3	100	55	4.1	5.7	90.0	7.0	0.0	171	15.9	40.7	12.4	34.2	5.78	39.4	9.14	1.15	351
NPB 120 X 60 X	10.37	13.2	120	64	4.4	6.3	90.0	7.0	0.0	317	27.6	49.0	14.4	52.9	8.64	60.7	13.5	1.69	889
NPB 140 X 70 X	12.89	16.4	140	73	4.7	6.9	90.0	7.0	0.0	541	44.9	57.4	16.5	77.3	12.3	88.3	19.2	2.40	1 980
NPB 160 X 80 X	15.77	20.0	160	82	5.0	7.4	90.0	9.0	0.0	869	68.3	65.7	18.4	108	16.6	123	26.1	3.54	3 950
NPB 180 X 90 X	15.37	19.5	177	91	4.3	6.5	90.0	9.0	0.0	1 060	81.8	73.6	20.4	120	17.9	135	27.9	2.67	5 930
NPB 180 X 90 X	18.80	23.9	180	91	5.3	8.0	90.0	9.0	0.0	1 310	100	74.1	20.5	146	22.1	166	34.6	4.72	7 430
NPB 180 X 90 X	21.27	27.0	182	92	6.0	9.0	90.0	9.0	0.0	1 500	117	74.5	20.8	165	25.4	189	39.9	6.64	8 730
NPB 200 X 100 X	18.43	23.4	197	100	4.5	7.0	90.0	12.0	0.0	1 590	117	82.3	22.3	161	23.4	181	36.5	4.13	10 500
NPB 200 X 100 X	22.36	28.4	200	100	5.6	8.5	90.0	12.0	0.0	1 940	142	82.6	22.3	194	28.4	220	44.6	6.92	12 900
NPB 200 X 100 X	25.09	31.9	202	102	6.2	9.5	90.0	12.0	0.0	2 210	168	83.1	22.9	218	33.1	249	51.8	9.36	15 500

Table 3 (*Continued*)

Designation	*Mass,* M	Area A	Dimensions							Properties										
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_x	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
NPB 200 X 130 X	27.37	34.8	207	133	5.8	8.5	90.0	12.0	0.0	2 660	334	87.4	30.9	257	50.2	288	77.4	8.48	32 800
NPB 200 X 130 X	31.56	40.1	210	134	6.4	10.0	90.0	12.0	0.0	3 150	401	88.5	31.6	300	59.9	337	92.4	12.8	40 100
NPB 200 X 150 X	30.46	38.7	194	150	6.0	9.0	90.0	12.0	0.0	2 670	507	83.0	36.1	275	67.6	306	103	10.4	43 300
NPB 200 X 165 X	35.69	45.4	201	165	6.2	10.0	90.0	12.0	0.0	3 410	749	86.6	40.6	339	90.8	376	138	14.5	68 200
NPB 200 X 165 X	42.48	54.1	205	166	7.2	12.0	90.0	12.0	0.0	4 160	915	87.7	41.1	406	110	454	168	24.1	85 100
NPB 200 X 165 X	48.00	61.1	210	166	6.5	14.5	90.0	12.0	0.0	5 020	1 100	90.6	42.5	478	133	534	202	37.9	105 000
NPB 220 X 110 X	22.18	28.2	217	110	5.0	7.7	90.0	12.0	0.0	2 310	171	90.5	24.6	213	31.1	240	48.4	5.68	18 700
NPB 220 X 110 X	26.20	33.3	220	110	5.9	9.2	90.0	12.0	0.0	2 770	204	91.1	24.7	251	37.2	285	58.1	9.03	22 600
NPB 220 X 110 X	29.35	37.3	222	112	6.6	10.2	90.0	12.0	0.0	3 130	239	91.5	25.3	282	42.8	321	66.9	12.1	26 700
NPB 240 X 120 X	26.15	33.3	237	120	5.2	8.3	90.0	15.0	0.0	3 290	240	99.3	26.8	277	40.0	311	62.3	8.51	31 200
NPB 240 X 120 X	30.71	39.1	240	120	6.2	9.8	90.0	15.0	0.0	3 890	283	99.7	26.9	324	47.2	366	73.9	12.9	37 300
NPB 240 X 120 X	34.32	43.7	242	122	7.0	10.8	90.0	15.0	0.0	4 360	328	99.9	2.74	361	53.8	410	84.3	17.1	43 600
NPB 250 X 125 X	30.11	38.3	250	125	6.0	9.0	90.0	15.0	0.0	4 130	294	103	27.7	331	47.0	373	73.6	11.1	42 500
NPB 250 X 150 X	34.08	43.4	258	146	6.1	9.2	90.0	15.0	0.0	5 120	478	108	33.2	396	65.5	444	101	12.8	73 800
NPB 250 X 150 X	39.78	50.6	262	147	6.6	11.2	90.0	15.0	0.0	6 200	594	110	34.2	473	80.8	530	124	20.3	93 200
NPB 250 X 150 X	46.48	59.2	266	148	7.6	13.2	90.0	15.0	0.0	7 380	715	111	34.7	554	96.6	625	149	31.5	113 000
NPB 250 X 175 X	43.94	55.9	244	175	7.0	11.0	90.0	15.0	0.0	6 090	984	104	41.9	499	112	555	172	22.4	133 000
NPB 270 X 135 X	30.73	39.1	267	135	5.5	8.7	90.0	15.0	0.0	4 910	357	112	30.2	368	53.0	412	82.3	10.4	59 500
NPB 270 X 135 X	36.07	45.9	270	135	6.6	10.2	90.0	15.0	0.0	5 780	419	112	30.2	428	62.2	483	96.9	15.9	70 500
NPB 270 X 135 X	42.26	53.8	274	136	7.5	12.2	90.0	15.0	0.0	6 940	513	113	30.8	507	75.5	574	117	25.0	87 600
NPB 300 X 150 X	36.53	46.5	297	150	6.1	9.2	90.0	15.0	0.0	7 170	518	124	33.4	483	69.1	541	107	13.3	107 000
NPB 300 X 150 X	42.24	53.8	300	150	7.1	10.7	90.0	15.0	0.0	8 350	603	124	33.5	557	80.5	628	125	19.9	125 000
NPB 300 X 150 X	49.32	62.8	304	152	8.0	12.7	90.0	15.0	0.0	9 990	745	126	34.4	657	98.1	743	152	30.9	157 000
NPB 300 X 165 X	39.88	50.7	310	165	5.8	9.7	90.0	15.0	0.0	8 790	727	131	37.8	567	88.1	630	135	15.4	163 000

Table 3 (*Continued*)

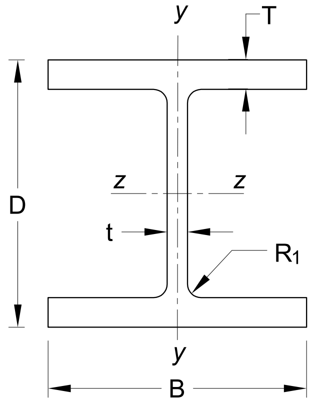
Designation	*Mass,* *M*	Area *A*	Dimensions							Properties									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_x	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
NPB 300 X 165 X	45.76	58.2	313	166	6.6	11.2	90.0	15.0	0.0	10 200	855	132	38.3	652	103	727	158	22.5	194 000
NPB 300 X 165 X	53.46	68.1	317	167	7.6	13.2	90.0	15.0	0.0	12 100	1 020	133	38.8	764	122	857	189	35.2	236 000
NPB 300 X 200 X	59.57	75.8	303	203	7.5	13.1	90.0	15.0	0.0	12 800	1 820	130	49.0	848	180	940	275	39.5	383 000
NPB 300 X 200 X	66.75	85.0	306	204	8.5	14.6	90.0	15.0	0.0	14 500	2 060	130	49.3	948	202	1 050	310	54.3	438 000
NPB 300 X 200 X	75.37	96.0	310	205	9.4	16.6	90.0	15.0	0.0	16 600	2 380	131	49.8	1 070	232	1 200	356	77.6	512 000
NPB 330 X 160 X	42.97	54.7	327	160	6.5	10.0	90.0	18.0	0.0	10 200	685	136	35.3	625	85.6	701	133	19.6	171 000
NPB 330 X 160 X	49.15	62.6	330	160	7.5	11.5	90.0	18.0	0.0	11 700	788	137	35.4	713	98.5	804	153	28.0	199 000
NPB 330 X 160 X	57.01	72.6	334	162	8.5	13.5	90.0	18.0	0.0	13 900	960	138	36.3	832	118	942	184	42.2	245 000
NPB 350 X 170 X	50.22	63.9	357.6	170	6.6	11.5	90.0	18.0	0.0	14 500	944	150	38.4	811	111	906	171	27.3	281 000
NPB 350 X 170 X	57.10	72.7	360	170	8.0	12.7	90.0	18.0	0.0	16 200	1 040	149	37.8	903	122	1 010	191	37.4	313 000
NPB 350 X 170 X	66.05	84.1	364	172	9.2	14.7	90.0	18.0	0.0	19 000	1 250	150	38.5	1 040	145	1 180	226	55.7	380 000
NPB 350 X 250 X	79.18	100	340	250	9.0	14.0	90.0	18.0	0.0	21 500	3 650	146	60.1	1 260	292	1 400	446	63.4	968 000
NPB 400 X 180 X	57.38	73.0	397	180	7.0	12.0	90.0	21.0	0.0	20 200	1 170	166	40.0	1 020	130	1 140	202	36.1	432 000
NPB 400 X 180 X	66.31	84.4	400	180	8.6	13.5	90.0	21.0	0.0	23 100	1 310	165	39.5	1 150	146	1 300	229	51.3	490 000
NPB 400 X 180 X	75.67	96.3	404	182	9.7	15.5	90.0	21.0	0.0	26 700	1 560	166	40.2	1 320	171	1 500	269	73.3	587 000
NPB 400 X 200 X	67.28	85.7	400	200	8.0	13.0	90.0	21.0	0.0	24 200	1 730	168	45.0	1 210	173	1 350	269	48.5	648 000
NPB 450 X190 X	67.16	85.5	447	190	7.6	13.1	90.0	21.0	0.0	29 700	1 500	186	41.9	1 330	158	1 490	245	47.1	704 000
NPB 450 X 190 X	77.58	98.8	450	190	9.4	14.6	90.0	21.0	0.0	33 700	1 670	184	41.1	1 490	176	1 700	276	66.7	791 000
NPB 450 X 190 X	92.37	117	456	192	11.0	17.6	90.0	21.0	0.0	40 900	2 080	186	42.1	1 790	217	2 040	340	109	997 000
NPB 500 X 200 X	79.36	101	497	200	8.4	14.5	90.0	21.0	0.0	42 900	1 930	206	43.8	1 720	193	1 940	301	64.3	1 120 000
NPB 500 X 200 X	90.69	115	500	200	10.2	16.0	90.0	21.0	0.0	48 100	2 140	204	43.0	1 920	214	2 190	335	89.1	1 240 000
NPB 500 X 200 X	107.32	136	506	202	12.0	19.0	90.0	21.0	0.0	57 700	2 620	205	43.7	2 280	259	2 610	408	142	1 540 000
NPB 550 X 210 X	92.08	117	547	210	9.0	15.7	90.0	24.0	0.0	59 900	2 430	226	45.5	2 190	231	2 470	361	89.3	1 710 000
NPB 550 X 210 X	105.52	134	550	210	11.1	17.2	90.0	24.0	0.0	67 100	2 660	223	44.5	2 440	254	2 780	400	122	1 880 000

Table 3 (*Concluded*)

Designation	***Mass,*** M	**Area** A	**Dimensions**							**Properties**									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_x	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
NPB 550 X 210 X	122.52	156	556	212	12.7	20.2	90.0	24.0	0.0	79 100	3 220	225	45.4	2 840	304	3 260	480	187	2 300 000
NPB 600 X 220 X	107.57	137	597	220	9.8	17.5	90.0	24.0	0.0	82 900	3 110	246	47.6	2 770	283	3 140	442	122	2 600 000
NPB 600 X 220 X	122.45	155	600	220	12.0	19.0	90.0	24.0	0.0	92 000	3 380	242	46.6	3 060	307	3 510	485	165	2 840 000
NPB 600 X 220 X	154.47	196	610	224	15.0	24.0	90.0	24.0	0.0	118 000	4 520	245	47.9	3 870	403	4 470	640	316	3 850 000
NPB 700 X 250 X	113.46	144	694	250	9.0	16.0	90.0	24.0	0.0	118 000	4 170	286	53.7	3 420	334	3 850	518	107	4 780 000
NPB 700 X 250 X	128.41	163	695	250	11.5	16.5	90.0	24.0	0.0	128 000	4 310	279	51.3	3 680	344	4 210	543	136	4 940 000
NPB 700 X 250 X	143.42	182	700	250	12.5	19.0	90.0	24.0	0.0	145 000	4 960	282	52.1	4 160	397	4 760	625	190	5 730 000
NPB 700 X 250 X	153.87	196	704	250	13.0	21.0	90.0	24.0	0.0	159 000	5 480	284	52.9	4 520	439	5 170	690	240	6 370 000
NPB 700 X 250 X	171.48	218	709	250	14.5	23.5	90.0	24.0	0.0	178 000	6 140	285	53.0	5 030	491	5 770	775	328	7 180 000
NPB 750 X 270 X	145.29	185	750	265	13.2	16.6	90.0	17.0	0.0	161 000	5 160	295	5.2.8	4 310	389	5 000	616	150	6 920 000
NPB 750 X 270 X	174.54	222	760	270	14.4	21.6	90.0	17.0	0.0	206 000	7 100	304	56.5	5 430	526	6 240	827	272	9 650 000
NPB 750 X 270 X	202.49	257	770	270	15.6	26.6	90.0	17.0	0.0	249 000	8 750	311	58.2	6 480	648	7 430	1 010	450	12 000 000

Table 4 Indian Standard Wide Parallel Flange Beams

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	*Mass,*	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 100 X 100 X	12.24	15.5	91	100	4.2	5.5	90.0	12.0	0.0	236	92.0	38.9	24.3	51.9	18.4	58.3	28.4	2.32	1 670
WPB 100 X 100 X	16.67	21.2	96	100	5.0	8.0	90.0	12.0	0.0	349	133	40.5	25.1	72.7	26.7	83.0	41.1	5.28	2 580
WPB 100 X 100 X	20.44	26.0	100	100	6.0	10.0	90.0	12.0	0.0	449	167	41.5	25.3	89.9	33.4	104	51.4	9.33	3 370
WPB 100 X 100 X	41.79	53.2	120	106	12.0	20.0	90.0	12.0	0.0	1 140	399	46.3	27.3	190	75.3	235	116	67.2	9 920
WPB 120 X 120 X	14.56	18.5	109	120	4.2	5.5	90.0	12.0	0.0	413	158	47.2	29.2	75.8	26.4	84.1	40.6	2.59	4 240
WPB 120 X 120 X	19.89	25.3	114	120	5.0	8.0	90.0	12.0	0.0	606	230	48.9	30.1	106	38.4	119	58.8	6.04	6 470
WPB 120 X 120 X	26.70	34.0	120	120	6.5	11.0	90.0	12.0	0.0	864	317	50.4	30.5	144	52.9	165	80.9	13.9	9 400
WPB 120 X 120 X	52.13	66.4	140	126	12.5	21.0	90.0	12.0	0.0	2 010	702	55.1	32.5	288	111	350	171	90.5	24 700
WPB 140 X 140 X	18.08	23.0	128	140	4.3	6.0	90.0	12.0	0.0	719	274	55.9	34.5	112	39.2	123	59.9	3.43	10 200
WPB 140 X 140 X	24.66	31.4	133	140	5.5	8.5	90.0	12.0	0.0	1 030	389	57.3	35.2	155	55.6	173	84.8	8.10	15 000
WPB 140 X 140 X	33.72	42.9	140	140	7.0	12.0	90.0	12.0	0.0	1 500	549	59.2	35.7	215	78.5	245	119	20.1	22 400
WPB 140 X 140 X	63.24	80.5	160	146	13.0	22.0	90.0	12.0	0.0	3 290	1 140	63.9	37.6	411	156	493	240	118	54 300

Table 4 (*Continued*)

Designation	*Mass*,	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 150 X 150 X	23.50	29.9	152	152	5.8	6.8	90.0	12.0	0.0	1 270	398	65.2	36.4	167	52.4	186	80.4	5.55	20 900
WPB 150 X 150 X	30.11	38.3	158	153	6.5	9.4	90.0	8.0	0.0	1 760	561	67.7	38.2	222	73.4	248	111	10.6	30 900
WPB 150 X 150 X	36.97	47.0	162	154	8.0	11.5	90.0	8.0	0.0	2 210	700	68.5	38.5	273	91.0	308	138	19.2	39 600
WPB 160 X 160 X	22.75	28.9	148	160	4.5	7.0	90.0	8.0	0.0	1 220	478	65.0	40.6	165	59.7	181	90.5	4.54	23 700
WPB 160 X 160 X	30.44	38.7	152	160	6.0	9.0	90.0	15.0	0.0	1 670	615	65.6	39.8	220	76.9	245	117	12.1	31 400
WPB 160 X 160 X	42.59	54.2	160	160	8.0	13.0	90.0	15.0	0.0	2 490	889	67.7	40.4	311	111	353	169	31.2	47 900
WPB 160 X 160 X	76.19	97.0	180	166	14.0	23.0	90.0	15.0	0.0	5 090	1 750	72.4	42.5	566	211	674	325	160	108 000
WPB 180 X 180 X	28.68	36.5	167	180	5.0	7.5	90.0	15.0	0.0	1 960	729	73.3	44.7	235	81.1	258	123	8.32	46 300
WPB 180 X 180 X	35.52	45.2	171	180	6.0	9.5	90.0	15.0	0.0	2 510	924	74.4	45.2	293	102	324	156	14.9	60 200
WPB 180 X 180 X	51.22	65.2	180	180	8.5	14.0	90.0	15.0	0.0	3 830	1 360	76.6	45.7	425	151	481	231	42.2	93 700
WPB 180 X180 X	88.90	113	200	186	14.5	24.0	90.0	15.0	0.0	7 480	2 580	81.2	47.7	748	277	883	425	201	199 000
WPB 200 X 200 X	34.65	44.1	186	200	5.5	8.0	90.0	18.0	0.0	2 940	1 060	81.6	49.2	316	106	347	163	12.5	84 400
WPB 200X200X	37.34	47.6	200	200	6.1	8.9	90.0	10.0	0.0	3 628	1 187	87.3	50.0	363	119	398	180	13.3	
WPB 200 X 200 X	42.26	53.8	190	200	6.5	10.0	90.0	18.0	0.0	3 690	1 330	82.8	49.8	388	133	429	203	21.0	108 000
WPB 200 X 200 X	50.92	64.8	194	202	8.0	12.0	90.0	18.0	0.0	4 530	1 650	83.5	50.4	467	163	521	249	34.3	136 000
WPB 200 X 200 X	61.30	78.0	200	200	9.0	15.0	90.0	18.0	0.0	5 690	2 000	85.4	50.6	569	200	642	305	59.7	171 000
WPB 200 X 200 X	74.01	94.2	206	206	10.2	18.0	90.0	18.0	0.0	7 170	2 620	87.2	52.7	696	255	793	388	99.3	231 000
WPB 200 X 200 X	83.52	106	209	209	13.0	19.5	90.0	18.0	0.0	8 050	2 970	87.0	52.8	771	284	888	435	134	266 000
WPB 200 X 200 X	103.06	131	220	206	15.0	25.0	90.0	18.0	0.0	10 600	3 650	90.0	52.7	967	354	1 130	543	257	346 000
WPB 220 X 220 X	40.40	51.4	205	220	6.0	8.5	90.0	18.0	0.0	4 170	1 510	90.0	54.1	406	137	445	209	15.5	145 000
WPB 220 X 220 X	50.51	64.3	210	220	7.0	11.0	90.0	18.0	0.0	5 400	1 950	91.6	55.1	515	177	568	270	28.6	193 000
WPB 220 X 220 X	71.47	91.0	220	220	9.5	16.0	90.0	18.0	0.0	8 090	2 840	94.2	55.8	735	258	827	393	77.0	295 000
WPB 220 X 220 X	115.61	147	226	226	15.5	26.0	90.0	18.0	0.0	12 600	5 010	92.8	58.3	1 120	443	1 310	677	311	500 000
WPB 240 X 240 X	47.40	60.3	224	240	6.5	9.0	90.0	21.0	0.0	5 830	2 070	98.3	58.6	520	173	570	264	22.1	239 000
WPB 240 X 240 X	60.32	76.8	230	240	7.5	12.0	90.0	21.0	0.0	7 760	2 760	100	60.0	675	230	744	351	42.1	328 000

Table 4 (*Continued*)

Designation	*Mass*,	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 240 X 240 X	83.20	105	240	240	10.0	17.0	90.0	21.0	0.0	11 200	3 920	103	60.8	938	326	1 050	498	103	486 000
WPB 240 X 240 X	156.68	199	270	248	18.0	32.0	90.0	21.0	0.0	24 200	8 150	110	63.9	1 790	657	2 110	1 000	626	1 150 000
WPB 250 X 250 X	67.22	85.6	247	252	11.0	11.1	90.0	24.0	0.0	9 390	2 960	104	58.9	760	235	851	364	51.3	411 000
WPB 250 X 250 X	73.15	93.1	252	250	9.0	13.6	90.0	24.0	0.0	11 000	3 540	109	61.7	880	283	977	434	67.6	503 000
WPB 250 X 250 X	85.04	108	253	255	14.0	14.1	90.0	24.0	0.0	12 100	3 910	105	60.0	961	306	1 080	475	95.6	555 000
WPB 250 X 250 X	97.04	123	260	256	12.7	17.6	90.0	24.0	0.0	15 000	4 930	110	63.1	1 150	385	1 300	591	140	722 000
WPB 250 X 250 X	103.97	132	264	257	11.9	19.6	90.0	24.0	0.0	16 700	5 550	112	64.7	1 270	432	1 430	660	174	828 000
WPB 250 X 250 X	117.58	149	269	259	13.5	22.1	90.0	24.0	0.0	19 300	6 410	113	65.4	1 430	495	1 630	757	244	975 000
WPB 250 X 250 X	133.92	170	275	261	15.4	25.1	90.0	24.0	0.0	22 500	7 450	114	66.1	1 640	571	1 880	874	351	1 160 000
WPB 250 X 250 X	148.38	189	280	263	17.3	27.6	90.0	24.0	0.0	25 400	8 380	115	66.6	1 810	637	2 100	978	466	1 330 000
WPB 260 X 260 X	54.15	68.9	244	260	6.5	9.5	90.0	24.0	0.0	7 980	2 780	107	63.5	654	214	714	327	30.1	382 000
WPB 260 X 260 X	68.16	86.8	250	260	7.5	12.5	90.0	24.0	0.0	10 400	3 660	109	65.0	836	282	919	430	54.2	516 000
WPB 260 X 260 X	92.99	118	260	260	10.0	17.5	90.0	24.0	0.0	14 900	5 130	112	65.8	1 140	394	1 280	602	126	753 000
WPB 260 X 260 X	114.40	145	268	262	12.5	21.5	90.0	24.0	0.0	18 900	6 450	113	66.5	1 410	492	1 590	752	224	978 000
WPB 260 X 260 X	141.52	180	278	265	15.5	26.5	90.0	24.0	0.0	24 300	8 230	116	67.5	1 750	621	2 010	950	407	1 290 000
WPB 260 X 260 X	172.43	219	290	268	18.0	32.5	90.0	24.0	0.0	31 300	10 400	119	68.9	2 150	779	2 520	1 190	720	1 720 000
WPB 280 X 280 X	61.26	78.0	264	280	7.0	10.0	90.0	24.0	0.0	10 500	3 660	116	68.5	799	261	873	399	35.5	590 000
WPB 280 X 280 X	76.36	97.2	270	280	8.0	13.0	90.0	24.0	0.0	13 600	4 760	118	69.9	1 010	340	1 110	518	63.5	785 000
WPB 280 X 280 X	188.54	240	310	288	18.5	33.0	90.0	24.0	0.0	39 500	13 100	128	74.0	2 550	914	2 960	1 390	807	2 520 000
WPB 280 X 280 X	284.13	361.95	280	280	10.5	18.0	90.0	24.0	0.0	30 682.9	9 105.2	9.21	5.0.2	2 191.6	650.4	2 941.1	1 406.8	146	1 130 000
WPB 300 X 300 X	69.80	88.9	283	300	7.5	10.5	90.0	27.0	0.0	13 800	4 730	124	72.9	975	315	1 060	482	47.8	877 000
WPB 300 X 300 X	88.34	112	290	300	8.5	14.0	90.0	27.0	0.0	18 200	6 300	127	74.8	1 250	420	1 380	641	87.8	1 190 000
WPB 300 X 300 X	100.85	128	294	300	10.0	16.0	90.0	27.0	0.0	21 000	7 210	128	74.9	1 430	480	1 580	733	124	1 390 000
WPB 300 X 300 X	117.03	149	300	300	11.0	19.0	90.0	27.0	0.0	25 100	8 560	129	75.7	1 670	570	1 860	870	189	1 680 000

Table 4 (*Continued*)

Designation	*Mass,* M	Area A	Dimensions							Properties									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 300 X 300 X	237.92	303	340	310	21.0	39.0	90.0	27.0	0.0	59 200	19 400	139	80.0	3 480	1 250	4 070	1 910	1 410	4 380 000
WPB 320 X 300 X	74.25	94.5	301	300	8.0	11.0	90.0	27.0	0.0	16 400	4 950	131	72.4	1 090	330	1 190	505	53.6	1 040 000
WPB 320 X 300 X	97.64	124	310	300	9.0	15.5	90.0	27.0	0.0	22 900	6 980	135	74.9	1 470	465	1 620	709	111	1 510 000
WPB 320 X 300 X	126.66	161	320	300	11.5	20.5	90.0	27.0	0.0	30 800	9 230	138	75.6	1 920	615	2 140	939	230	2 060 000
WPB 320 X 300 X	244.97	312	359	309	21.0	40.0	90.0	27.0	0.0	68 100	19 700	147	79.4	3 790	1 270	4 430	1 950	1 500	5 000 000
WPB 340 X 300 X	78.90	100	320	300	8.5	11.5	90.0	27.0	0.0	19 500	5 180	139	71.8	1 220	345	1 340	529	60.1	1 230 000
WPB 340 X 300 X	104.78	133	330	300	9.5	16.5	90.0	27.0	0.0	27 600	7 430	144	74.6	1 670	495	1 850	755	131	1 820 000
WPB 340 X 300 X	134.16	170	340	300	12.0	21.5	90.0	27.0	0.0	36 600	9 680	146	75.3	2 150	645	2 400	985	262	2 450 000
WPB 340 X 300 X	290.64	315	377	309	21.0	40.0	90.0	27.0	0.0	76 300	19 700	155	79.0	4 050	1 270	4 710	1 950	1 510	5 580 000
WPB 360 X 300 X	91.04	106	339	300	9.0	12.0	90.0	27.0	0.0	23 000	5 410	147	71.2	1 350	360	1 490	552	67.2	1 440 000
WPB 360 X 300 X	125.81	142	350	300	10.0	17.5	90.0	27.0	0.0	33 000	7 880	152	74.3	1 890	525	2 080	802	153	2 170 000
WPB 360 X 300 X	163.00	180	360	300	12.5	22.5	90.0	27.0	0.0	43 100	10 100	154	74.9	2 390	676	2 680	1 030	298	2 880 000
WPB 360 X 300 X	250.27	318	395	308	21.0	40.0	90.0	27.0	0.0	84 800	19 500	163	78.2	4 290	1 260	4 980	1 940	1 510	6 130 000
WPB 360 X 370 X	136.21	173	356	369	11.2	17.8	90.0	27.0	0.0	42 100	14 900	155	92.7	2 360	808	2 600	1 220	192	4 260 000
WPB 360 X 370 X	150.87	192	360	370	12.3	19.8	90.0	27.0	0.0	47 300	16 700	156	93.3	2 620	904	2 900	1 370	256	4 830 000
WPB 360 X 370 X	165.35	210	364	371	13.3	21.8	90.0	27.0	0.0	52 500	18 500	157	93.9	2 880	1 000	3 200	1 520	333	5 430 000
WPB 360 X 370 X	182.02	231	368	373	15.0	23.8	90.0	27.0	0.0	58 200	20 600	158	94.2	3 160	1 100	3 530	1 680	432	6 090 000
WPB 360 X 370 X	197.66	251	372	374	16.4	25.8	90.0	27.0	0.0	63 900	22 500	159	94.5	3 430	1 200	3 850	1 830	546	6 740 000
WPB 400 X 300 X	92.40	117	378	300	9.5	13.0	90.0	27.0	0.0	31 200	5 860	162	70.5	1 650	390	1 820	599	81.4	1 940 000
WPB 400 X 300 X	124.81	158	390	300	11.0	19.0	90.0	27.0	0.0	45 000	8 560	168	73.3	2 310	570	2 560	872	193	2 940 000
WPB 400 X 300 X	155.26	197	400	300	13.5	24.0	90.0	27.0	0.0	57 600	10 800	170	73.9	2 880	721	3 230	1 100	361	3 810 000
WPB 400 X 300 X	255.74	325	432	307	21.0	40.0	90.0	27.0	0.0	104 000	19 300	178	77.0	4 820	1 250	5 570	1 930	1 520	7 410 000
WPB 400 X 400 X	191.11	243	368	391	15.0	24.2	90.0	27.0	0.0	61 500	24 100	159	99.5	3 340	1 230	3 730	1 870	467	7 120 000
WPB 400 X 400 X	219.67	279	375	394	17.3	27.7	90.0	27.0	0.0	72 100	28 200	160	100	3 840	1 430	4 320	2 180	691	8 510 000

Table 4 (*Continued*)

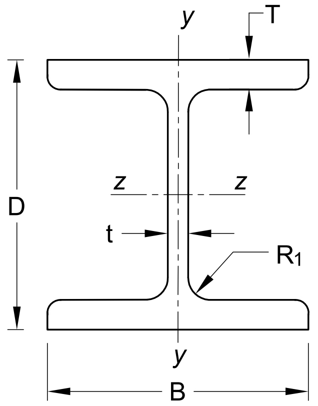
Designation	*Mass,* M	Area A	Dimensions							Properties									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 400 X 400 X	239.62	305	380	395	18.9	30.2	90.0	27.0	0.0	79 700	31 000	161	100	4 190	1 570	4 750	2 390	887	9 480 000
WPB 450 X 300 X	99.75	127	425	300	10.0	13.5	90.0	27.0	0.0	41 800	6 080	181	69.2	1 970	405	2 180	624	91.4	2 570 000
WPB 450 X 300 X	139.76	178	440	300	11.5	21.0	90.0	27.0	0.0	63 700	9 460	189	72.9	2 890	631	3 210	965	250	4 140 000
WPB 450 X 300 X	171.12	217	450	300	14.0	26.0	90.0	27.0	0.0	79 800	11 700	191	73.3	3 550	781	3 980	1 190	448	5 250 000
WPB 450 X 300 X	263.33	335	478	307	21.0	40.0	90.0	27.0	0.0	131 000	19 300	197	75.9	5 500	1 250	6 330	1 930	1 530	9 250 000
WPB 500 X 300 X	107.46	136	472	300	10.5	14.0	90.0	27.0	0.0	54 600	6 310	199	67.9	2 310	420	2 570	649	102	3 300 000
WPB 500 X 300 X	129.78	165	480	300	11.5	18.0	90.0	27.0	0.0	68 900	8 110	204	70.0	2 870	541	3 190	832	179	4 320 000
WPB 500 X 300 X	155.08	197	490	300	12.0	23.0	90.0	27.0	0.0	86 900	10 300	209	72.4	3 540	691	3 940	1 050	317	5 640 000
WPB 500 X 300 X	187.34	238	500	300	14.5	28.0	90.0	27.0	0.0	107 000	12 600	211	7.2.7	4 280	841	4 810	1 290	548	7 010 000
WPB 500 X 300 X	270.28	344	524	306	21.0	40.0	90.0	27.0	0.0	161 000	19 100	216	74.5	6 180	1 250	7 090	1 930	1 540	11 100 000
WPB 550 X 300 X	119.99	152	522	300	11.5	15.0	90.0	27.0	0.0	72 800	6 760	218	66.5	2 790	451	3 120	698	126	4 330 000
WPB 550 X 300 X	166.24	211	540	300	12.5	24.0	90.0	27.0	0.0	111 000	10 800	229	71.4	4 140	721	4 620	1 100	360	7 180 000
WPB 550 X 300 X	199.44	254	550	300	15.0	29.0	90.0	27.0	0.0	136 000	13 000	231	71.7	4 970	871	5 590	1 340	610	8 850 000
WPB 550 X 300 X	278.19	354	572	306	21.0	40.0	90.0	27.0	0.0	197 000	19 100	236	73.5	6 920	1 250	7 930	1 930	1 550	13 500 000
WPB 600 X300 X	128.79	164	571	300	12.0	15.5	90.0	27.0	0.0	91 800	6 990	236	65.2	3 210	466	3 620	724	141	5 380 000
WPB 600 X 300 X	177.78	226	590	300	13.0	25.0	90.0	27.0	0.0	141 000	11 200	249	70.5	4 780	751	5 350	1 150	407	8 970 000
WPB 600 X300 X	211.92	269	600	300	15.5	30.0	90.0	27.0	0.0	171 000	13 500	251	70.8	5 700	902	6 420	1 390	677	10 900 000
WPB 600 X300 X	285.48	363	620	305	21.0	40.0	90.0	27.0	0.0	237 000	18 900	255	722	7 650	1 240	8 770	1 930	1 560	15 900 000
WPB 650 X300 X	137.98	175	620	300	12.5	16.0	90.0	27.0	0.0	113 000	7 220	254	64.1	3 670	481	4 150	750	158	6 560 000
WPB 650 X300 X	189.69	241	640	300	13.5	26.0	90.0	27.0	0.0	175 000	11 700	269	69.6	5 470	781	6 130	1 200	457	11 000 000
WPB 650 X300 X	224.78	286	650	300	16.0	31.0	90.0	27.0	0.0	210 000	13 900	271	6.9.8	6 480	932	7 310	1 440	749	13 300 000
WPB 650 X300 X	293.39	373	668	305	21.0	40.0	90.0	27.0	0.0	281 000	18 900	274	71.2	8 430	1 240	9 650	1 930	1 580	18 600 000
WPB 700 X300 X	149.89	190	670	300	13.0	17.0	90.0	27.0	0.0	142 000	7 670	273	63.3	4 260	511	4 840	799	186	8 150 000
WPB 700 X300 X	204.48	260	690	300	14.5	27.0	90.0	27.0	0.0	215 000	12 100	287	68.3	6 240	811	7 030	1 250	521	13 300 000

Table 4 (*Concluded*)

Designation	***Mass,*** M	**Area** A	**Dimensions**							**Properties**									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
WPB 700 X300 X	240.51	306	700	300	17.0	32.0	90.0	27.0	0.0	256 000	14 400	289	68.6	7 330	962	8 320	1 490	839	16 000 000
WPB 700 X300 X	300.68	383	716	304	21.0	40.0	90.0	27.0	0.0	329 000	18 700	293	70.0	9 190	1 230	10 500	1 920	1 590	21 300 000
WPB 800 X300 X	171.52	218	770	300	14.0	18.0	90.0	30.0	0.0	208 000	8 130	309	61	5 420	542	6 220	856	243	11 400 000
WPB 800 X300 X	224.38	285	790	300	15.0	28.0	90.0	30.0	0.0	303 000	12 600	325	66.5	7 680	842	8 690	1 310	608	18 200 000
WPB 800 X300 X	262.34	334	800	300	17.5	33.0	90.0	30.0	0.0	359 000	14 900	327	66.7	8 970	993	10 200	1 550	958	21 800 000
WPB 800 X300 X	317.36	404	814	303	21.0	40.0	90.0	30.0	0.0	442 000	18 600	330	67.8	10 800	1 220	12 400	1 930	1 650	27 700 000
WPB 800 X300 X	179.90	229	835	292	14.0	18.8	90.0	30.0	0.0	253 000	7 830	332	58.4	6 080	536	7 000	851	264	12 900 000
WPB 850 X300 X	195.74	249	840	292	14.7	21.3	90.0	30.0	0.0	282 000	8 870	336	59.6	6 720	608	7 730	961	343	14 800 000
WPB 850 X300 X	214.25	272	846	293	15.4	24.3	90.0	30.0	0.0	317 000	10 200	341	61.2	7 500	698	8 600	1 100	459	17 100 000
WPB 850 X300 X	230.56	293	851	294	16.1	26.8	90.0	30.0	0.0	347 000	11 300	344	62.3	8 160	775	9 350	1 220	579	19 200 000
WPB 850 X300 X	253.69	323	859	292	17.0	30.8	90.0	30.0	0.0	392 000	12 800	348	63.0	9 130	879	10 400	1 380	802	21 900 000
WPB 900 X300 X	198.01	252	870	300	15.0	20.0	90.0	30.0	0.0	301 000	9 040	345	59.8	6 920	602	7 990	957	321	16 200 000
WPB 900 X300 X	251.62	320	890	300	16.0	30.0	90.0	30.0	0.0	422 000	13 500	362	65.0	9 480	903	10 800	1 410	749	24 900 000
WPB 900 X300 X	291.46	371	900	300	18.5	35.0	90.0	30.0	0.0	494 000	15 800	364	65.2	10 900	1 050	12 500	1 650	1 150	29 400 000

Table 5 Nominal Dimensions, Mass and Sectional Properties of Column/Heavy Weight Beam Sections

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	**Mass,** M	**Area** A	**Dimensions**							**Properties**									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
SC 100	19.97	25.4	100	100	6.0	10.0	98.0	12.0	6.0	434	136	41.3	23.1	87.0	27.2	101	45.2	10.6	3 370
SC 120	26.22	33.4	120	120	6.5	11.0	98.0	12.0	6.0	840	255	50.2	27.7	140	42.6	161	70.8	16.5	9 400
SC 140	33.25	42.3	140	140	7.0	12.0	98.0	12.0	6.0	1 470	437	59.0	32.1	210	62.5	240	104	24.6	22 400
SC 150*	36.93	47.0	152	152	7.9	11.9	98.0	11.7	3.0	1 920	554	63.9	34.3	253	72.9	288	122	27.6	34 100
SC 160	41.85	53.3	160	160	8.0	13.0	98.0	15.0	7.5	2 410	694	67.4	36.1	302	86.8	345	146	38.3	47 900
SC 180	50.48	64.3	180	180	8.5	14.0	98.0	15.0	7.5	3 730	1 050	76.2	40.5	414	117	471	197	52.8	93 700
SC 200	60.24	76.7	200	200	9.0	15.0	98.0	18.0	9.0	5 520	1 520	84.9	44.6	552	152	627	259	74.9	171 000
SC 220	70.41	89.6	220	220	9.5	16.0	98.0	18.0	9.0	7 860	2 150	93.7	49.0	715	196	809	333	98.4	295 000
SC 250	85.54	108	250	250	10.0	17.0	98.0	23.0	11.5	12 400	3 250	106	54.7	995	260	1 120	448	143	600 000

Table 5 (*Concluded*)

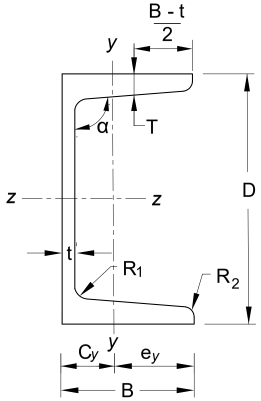
Designation	Mass, M	Area A	Dimensions							Properties									
			D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Heavy Weight Beams and Columns																			
HB 150	27.06	34.4	150	150	5.4	9.0	94.0	8.0	4.0	1 450	431	64.9	35.3	194	57.5	215	92.7	10.1	25 100
HB 150*	30.15	38.4	150	150	8.4	9.0	94.0	8.0	4.0	1 510	435	62.7	33.6	201	58.0	228	94.7	12.6	25 100
HB 150*	33.66	42.9	150	150	11.8	9.0	94.0	8.0	4.0	1 570	439	60.6	32.0	210	58.6	243	97.6	17.4	25 100
HB 200	37.31	47.5	200	200	6.1	9.0	94.0	9.0	4.5	3 600	967	87.1	45.1	360	96.7	397	159	14.9	109 000
HB 200*	39.73	50.6	200	200	7.8	9.0	94.0	9.0	4.5	3 690	971	85.4	43.8	369	97.1	411	160	16.6	109 000
HB 225	43.12	54.9	225	225	6.5	9.1	94.0	10.0	5.0	5 280	1 350	98.0	49.6	469	120	515	200	18.3	201 000
HB 225*	46.52	59.2	225	225	8.6	9.1	94.0	10.0	5.0	5 430	1 360	95.7	47.9	483	121	538	203	20.8	201 000
HB 250	50.98	64.9	250	250	6.9	9.7	94.0	10.0	5.0	7 730	1 960	109	54.9	619	156	678	262	24.5	364 000
HB 250*	54.41	69.3	250	250	8.8	9.7	94.0	10.0	5.0	7 930	1 970	106	53.3	634	157	704	264	27.2	364 000
HB 300	58.74	74.8	300	250	7.6	10.6	94.0	11.0	5.5	12 500	2 190	129	54.1	836	175	921	291	32.4	577 000
HB 300*	62.67	79.8	300	250	9.4	10.6	94.0	11.0	5.5	12 800	2 200	126	52.5	858	176	956	294	36.2	577 000
HB 350	67.42	85.9	350	250	8.3	11.6	94.0	12.0	6.0	19 100	2 450	149	53.4	1 090	196	1 210	324	42.8	864 000
HB 350*	72.03	91.7	350	250	10.1	11.6	94.0	12.0	6.0	19 600	2 460	146	51.7	1 120	196	1 260	328	48.3	864 000
HB 400	77.43	98.6	400	250	9.1	12.7	94.0	14.0	7.0	28 000	2 720	168	52.5	1 400	218	1 560	360	57.8	1 240 000
HB 400*	81.83	104	400	250	10.6	12.7	94.0	14.0	7.0	28 700	2 730	166	51.2	1 430	218	1 610	364	63.9	1 240 000
HB 450	87.22	111	450	250	9.8	13.7	94.0	15.0	7.5	39 200	2 980	187	51.8	1 740	238	1 950	394	73.5	1 690 000
HB 450*	92.19	117	450	250	11.3	13.7	94.0	15.0	7.5	40 100	2 990	184	50.4	1 780	239	2 020	398	81.5	1 690 000

NOTE — HB sections are also used as column sections.

* These heavier sections in each size are obtained from the same set of rolls as the lighter sections by spreading of the rolls. Therefore, while ordering these heavier sections, mass should be mentioned

Table 6 Dimensions, Mass and Sectional Properties of Sloping Flange Channels (Medium Channels)

(*Clauses* 4.1, 7.1 *and* 9.1)



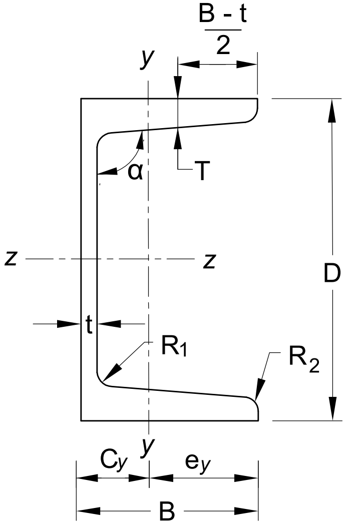
Designation	*Mass*	Area	Dimensions							Properties										
	M	*A*	*D*	*B*	*t*	*T*	Slope (α)	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
MC 75	7.14	9.08	75	40	4.8	7.5	96.0	8.5	2.4	13.2	78.2	12.7	39.4	11.8	20.9	4.80	25.0	9.00	1.59	132
MC 100	9.56	12.1	100	50	5	7.7	96.0	9.0	2.4	15.4	191	26.3	39.7	14.7	38.4	7.60	45.2	14.8	2.25	512
MC 125	13.1	16.6	125	65	5.3	8.2	96.0	9.5	2.4	19.5	424	60.3	50.5	19.0	67.9	13.3	78.9	26.0	3.59	1 900
MC 125*	13.7	17.4	125	66	6	8.1	96.0	9.5	2.4	19.2	433	63.7	49.8	19.1	69.4	13.6	81.2	27.1	3.90	2 030
MC 150	16.8	21.3	150	75	5.7	9	96.0	10.0	2.4	22.0	786	102	60.8	21.9	104	19.3	121	38.1	5.45	4 700
MC 150*	17.7	22.5	150	76	6.5	9	96.0	10.0	2.4	21.7	810	108	60.0	22.0	108	20.0	126	40.0	6.07	5 060
MC 175	19.6	24.8	175	75	6	10.2	96.0	10.5	3.2	21.9	1 230	120	70.4	22.0	141	22.7	163	44.7	7.49	7 450
MC 175*	22.7	27.3	175	76	7.5	10.2	96.0	10.5	3.2	21.4	1 290	130	68.7	21.8	147	23.7	174	47.4	9.01	8 250
MC 200	22.3	28.4	200	75	6.2	11.4	96.0	11.0	3.2	22.0	1 820	139	80.2	22.1	182	26.2	212	51.2	9.89	11 000
MC 200*	24.3	30.9	200	76	7.5	11.4	96.0	11.0	3.2	21.2	1 900	149	78.5	22.0	190	27.3	224	53.8	11.4	12 100
MC 225	26.1	33.2	225	80	6.5	12.4	96.0	12.0	3.2	23.1	2 700	185	90.2	23.6	240	32.7	279	63.8	13.3	18 700
MC 225*	30.7	38.7	225	82	9	12.4	96.0	12.0	3.2	22.2	2 920	210	86.9	23.3	260	35.1	309	68.6	17.6	22 000
MC 250	30.6	38.9	250	80	7.2	14.1	96.0	12.0	3.2	23.0	3 820	218	99.2	23.7	306	38.2	358	74.2	18.9	26 800

Table 6 (*Concluded*)

Designation	***Mass***	**Area**	**Dimensions**							**Properties**										
	M	A	D	B	t	T	Slope (α)	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
MC 250*	34.2	43.4	250	82	9	14.1	96.0	12.0	3.2	22.3	4 060	242	96.8	2.36	325	40.7	386	78.7	22.8	30 600
MC 250*	38.1	48.1	250	83	11	14.1	96.0	12.0	3.2	21.9	4 280	258	94.4	2.32	342	42.1	414	80.8	28.5	33 800
MC 300	36.3	46.2	300	90	7.8	13.6	96.0	13.0	3.2	23.5	6 400	311	117	2.59	427	46.8	501	91.9	21.7	57 500
MC 300*	41.5	52.7	300	92	10	13.6	96.0	13.0	3.2	22.6	6 880	344	114	2.55	458	49.6	549	96.3	28.1	66 100
MC 300*	46.2	58.4	300	93	12	13.6	96.0	13.0	3.2	22.2	7 260	363	111	2.49	484	51.2	589	98.7	36.1	72 300
MC 350	42.7	54.3	350	100	8.3	13.5	96.0	14.0	4.8	24.4	10 000	429	136	2.81	575	56.8	677	112	26.1	112 000
MC 400	50.1	63.7	400	100	8.8	15.3	96.0	15.0	4.8	24.2	15 100	504	154	2.81	758	66.5	898	129	36.1	170 000

Table 7 Dimensions, Mass and Sectional Properties of Sloping Flange Channels (Junior and Light Channels)

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	Mass	Dimensions								Properties										
	M	A	D	B	t	T	Slope (α)	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	Kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Junior Channels																				
JC 100	5.8	7.41	100	45	3	5.1	91.5	6	2.0	14.0	123	14.6	40.9	14.0	24.8	4.70	28.4	8.80	0.519	264
JC 125	7.9	10.0	125	50	3	6.6	91.5	6	2.4	16.4	269	25.1	51.7	15.8	43.1	7.50	49.1	13.6	1.07	701
JC 150	9.9	12.6	150	55	3.6	6.9	91.5	7	2.4	16.7	471	37.4	61.0	17.2	62.9	9.80	72.1	18.1	1.47	1 520
JC 175	11.2	14.2	175	60	3.6	6.9	91.5	7	3.0	17.5	720	49.6	71.1	18.7	82.3	11.7	94.2	21.9	1.62	2 780
JC 200	14	17.7	200	70	4.1	7.1	91.5	8	3.2	19.7	1160	82.8	80.8	21.6	116	16.5	133	31.0	2.23	6 150
Light Channels																				
LC 75	5.7	7.26	75	40	3.7	6	91.5	6	2.0	13.5	65.9	11.3	30.1	12.5	17.6	4.30	20.6	7.70	0.726	110
LC 100	7.9	10.0	100	50	4	6.4	91.5	6	2.0	16.2	164	24.4	40.5	15.6	32.9	7.20	38.1	13.3	1.11	434

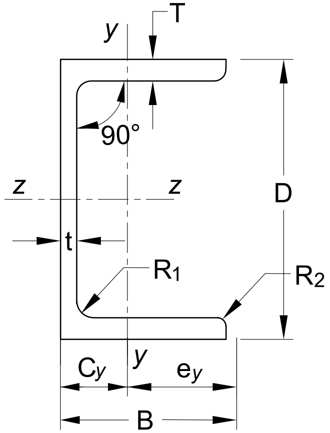
Table 7 (*Concluded*)

Designation	Mass	Dimensions								Properties											
	M	A	D	B	t	T	Slope (α)	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	Kg/m	$\times10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times10^4$ mm^4	$\times10^4$ mm^4	mm	mm	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^4$ mm^4	$\times10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
LC 125	10.7	13.6	125	65	4.4	6.6	91.5	7	2.4	20.4	356	56.3	51.1	20.3	57.1	12.6	65.4	23.4	1.68	1 590
LC (P) 125	11.3	14.3	125	65	4.6	7	96.0	7	2.4	18.7	370	50.6	50.8	18.8	59.2	10.9	68.3	22.0	2.27	1 670
LC 150	14.4	18.3	150	75	4.8	7.8	91.5	8	2.4	23.9	697	101	61.6	23.5	93.1	19.9	106	36.5	3.04	4 120
LC (P) 150	15.6	19.8	150	75	5	8.7	96.0	8	2.4	22.4	750	96.1	61.5	22.0	100	18.3	114	35.7	4.55	4 450
LC 175	17.6	22.4	175	75	5.1	9.5	91.5	8	3.2	24.0	1 140	124	71.6	23.6	131	24.4	150	44.7	5.07	6 830
LC 200	20.6	26.2	200	75	5.5	10.8	91.5	8.5	3.2	23.6	1 720	144	81.1	23.5	172	28.2	199	51.8	7.31	10 300
LC (P) 200	21.5	27.3	200	75	5.7	11.4	96.0	8.5	3.2	22.3	1 790	136	80.9	22.3	179	25.9	207	50.2	9.13	10 800
LC 225	24	30.5	225	90	5.8	10.2	96.0	11	3.2	24.7	2 550	207	91.4	26.0	226	31.8	260	64.2	9.30	22 200
LC 250	28	35.6	250	100	6.1	10.7	96.0	11	3.2	27.1	3 690	295	101	28.8	295	40.6	338	82.5	12.0	39 700
LC 300	33.1	42.1	300	100	6.7	11.6	96.0	12	3.2	25.6	6 050	344	119	28.6	403	46.3	467	94.2	15.6	66 400
LC (P) 300	33.1	42.1	300	90	7	12.5	96.0	12	3.2	23.2	5 910	282	118	25.9	394	42.4	460	84.3	16.8	53 000
LC 350	38.9	49.4	350	100	7.4	12.5	96.0	13	4.8	24.2	9 310	391	137	28.1	532	51.6	623	103	20.3	103 000
LC 400	45.8	58.2	400	100	8	14	96.0	14	4.8	23.7	13 900	457	155	28.0	699	60.0	825	117	27.9	157 000

NOTE — (P) stands for provisional section.

Table 8 Dimensions, Mass and Sectional Properties of Parallel Flange Channels

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	Mass	Dimensions								Properties											
	M	A	D	B	t	T	Slope	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
MPC 75	7.14	9.10	75	40	4.8	7.5	90	8.5	4.5	13.8	78.6	13.7	29.4	12.3	21.0	5.20	25.2	9.5	1.48	132
MPC 100	9.56	12.1	100	50	5	7.7	90	9.0	4.5	16.5	193	29.4	39.8	15.5	38.6	8.8	45.5	16.0	2.04	512
MPC 125	13.1	16.7	125	65	5.5	8.1	90	9.5	5.0	21.4	426	69.8	50.4	20.4	68.2	15.9	79.3	29.1	3.14	1 900
MPC 125*	13.7	17.5	125	66	6	8.1	90	9.5	5.0	21.1	437	74.1	50.0	20.6	69.9	16.5	81.7	30.2	3.40	2 030
MPC 150	16.8	21.3	150	75	5.7	9	90	10	5.0	24.6	792	120	60.9	23.7	105	23.8	122	43.2	4.71	4 700
MPC 150*	17.7	22.5	150	76	6.5	9	90	10	5.0	24.0	817	128	60.2	23.8	109	24.7	126	45.1	5.25	5 060
MPC 175	19.6	24.9	175	75	6	10.2	90	10.5	6.0	23.9	1 240	138	70.6	23.6	141	27.0	164	49.5	6.66	7 450
MPC 175*	21.7	27.6	175	77	7.5	10.2	90	10.5	6.0	23.2	1 310	155	69.0	23.7	150	28.9	176	53.0	8.10	8 550
MPC 200	22.3	28.4	200	75	6.2	11.4	90	11	6.0	23.4	1 830	157	80.3	23.5	183	30.5	213	55.9	8.99	11 000
MPC 200*	24.3	30.9	200	76	7.5	11.4	90	11	6.5	22.6	1 910	168	78.6	23.3	191	31.5	225	57.8	10.4	12 100
MPC 225	26.1	33.2	225	80	6.5	12.4	90	12	6.5	24.8	2 710	208	90.3	25.0	241	37.9	280	69.5	12.1	18 700
MPC 225*	30.7	39.0	225	83	9	12.4	90	12	7.0	23.7	2 960	244	87.2	25.1	263	41.3	312	75.3	16.2	22 800

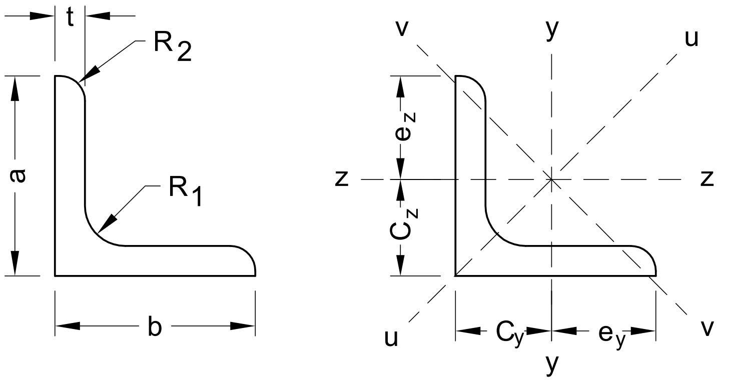
Table 8 (*Concluded*)

Designation	**Mass**	**Dimensions**								**Properties**										
	M	A	D	B	t	T	Slope	R_1	R_2	C_y	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
MPC 250	30.6	38.9	250	80	7.2	14.1	90	12	7.0	24.4	3 830	240	99.3	24.8	307	43.2	359	79.3	17.5	26 800
MPC 250*	34.2	43.4	250	82	9	14.1	90	12	7.0	23.6	4 080	267	96.9	24.8	326	45.9	387	83.5	21.1	30 600
MPC 250*	38.1	48.6	250	84	11	14.1	90	12	7.0	23.1	4 350	295	94.6	24.6	348	48.4	420	87.7	26.7	34 900
MPC 300	36.3	46.2	300	90	7.8	13.6	90	13	7.0	25.4	6 420	351	117	27.6	428	54.4	502	99.1	19.8	57 500
MPC 300*	41.5	52.8	300	92	10	13.6	90	13	7.0	24.2	6 910	390	114	27.2	460	57.5	551	103	25.7	66 100
MPC 300*	46.2	58.8	300	94	12	13.6	90	13	7.0	23.6	7 360	424	111	26.9	490	60.3	596	108	33.5	74 400
MPC 350	42.7	54.3	350	100	8.3	13.5	90	14	8.0	26.5	10 100	497	136	30.2	577	67.7	679	122	23.4	112 000
MPC 400	50.1	63.8	400	100	8.8	15.3	90	15	8.0	26.0	15 200	572	154	30.0	762	77.4	901	139	33.1	170 000

* These heavier sections in each size are obtained from the same set of rolls as the lighter sections by spreading of the rolls. Therefore, while ordering these heavier sections, mass should be mentioned.

Table 9 Nominal Dimensions, Mass and Sectional Properties of Indian Standard Equal Leg Angles

(*Clause* 4.1, 7.1 *and* 9.1)



Designation	Mass M	Area A	Dimensions					Properties															
			a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 20 × 20 × 3	0.90	1.14	20	20	3	4.0	0	6.0	6.0	0.40	0.40	0.79	0.64	0.17	5.9	5.9	7.5	3.9	0.29	0.29	0.52	0.53	0.033
× 4	1.16	1.47	20	20	4	4.0	0	6.4	6.4	0.50	0.50	0.79	0.79	0.22	5.8	5.8	7.3	3.9	0.37	0.37	0.66	0.67	0.076
∠ 25 × 25 × 3	1.14	1.45	25	25	3	4.5	0	7.3	7.3	0.83	0.83	0.79	1.30	0.35	7.5	7.5	9.5	4.9	0.46	0.46	0.83	0.84	0.042
× 4	1.48	1.88	25	25	4	4.5	0	7.6	7.6	1.04	1.04	0.79	1.63	0.44	7.4	7.4	9.3	4.8	0.60	0.60	1.07	1.09	0.098
× 5	1.80	2.29	25	25	5	4.5	0	8.0	8.0	1.23	1.23	0.79	1.92	0.54	7.3	7.3	9.2	4.8	0.72	0.72	1.30	1.31	0.187
∠ 30 × 30 × 3	1.38	1.76	30	30	3	5.0	0	8.5	8.5	1.47	1.47	0.79	2.32	0.62	9.1	9.1	11.5	5.9	0.68	0.68	1.22	1.23	0.051
× 4	1.80	2.29	30	30	4	5.0	0	8.9	8.9	1.86	1.86	0.79	2.94	0.78	9.0	9.0	11.3	5.8	0.88	0.88	1.58	1.60	0.119
× 5	2.20	2.80	30	30	5	5.0	0	9.3	9.3	2.22	2.22	0.79	3.49	0.95	8.9	8.9	11.2	5.8	1.07	1.07	1.92	1.94	0.229
∠ 35 × 35 × 3	1.62	2.06	35	35	3	5.0	0	9.7	9.7	2.38	2.38	0.79	3.77	0.99	.0.7	10.7	13.5	6.9	0.94	0.94	1.69	1.70	0.060
× 4	2.11	2.69	35	35	4	5.0	0	10.1	10.1	3.04	3.04	0.79	4.81	1.27	10.6	10.6	13.4	6.9	1.22	1.22	2.19	2.21	0.140
× 5	2.59	3.30	35	35	5	5.0	0	10.5	10.5	3.65	3.65	0.79	5.76	1.54	10.5	10.5	13.2	6.8	1.49	1.49	2.68	2.69	0.270
× 6	3.06	3.89	35	35	6	5.0	0	10.9	10.9	4.20	4.20	0.79	6.61	1.80	10.4	10.4	13.0	6.8	1.74	1.74	3.14	3.15	0.460

Table 9 (*Continued*)

Designation	Mass M	Area A	Dimensions					Properties															
			a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 40 × 40 × 3	1.86	2.37	40	40	3	5.5	0	10.9	10.9	3.61	3.61	0.79	5.72	1.51	12.3	12.3	15.5	8.0	1.24	1.24	2.22	2.24	0.069
× 4	2.44	3.10	40	40	4	5.5	0	11.3	11.3	4.63	4.63	0.79	7.34	1.93	12.2	12.2	15.4	7.9	1.62	1.62	2.90	2.92	0.162
× 5	2.99	3.81	40	40	5	5.5	0	11.7	11.7	5.58	5.58	0.79	8.83	2.33	12.1	12.1	15.2	7.8	1.97	1.97	3.55	3.57	0.312
× 6	3.54	4.50	40	40	6	5.5	0	12.1	12.1	6.46	6.46	0.79	10.2	2.73	12.0	12.0	15.0	7.8	2.32	2.32	4.17	4.19	0.532
∠ 45 × 45 × 3	2.10	2.67	45	45	3	5.5	0	12.2	12.2	5.20	5.20	0.79	8.20	2.17	13.9	13.9	17.6	9.0	1.58	1.58	2.84	2.86	0.078
× 4	2.75	3.50	45	45	4	5.5	0	12.6	12.6	6.70	6.70	0.79	10.6	2.78	13.8	13.8	17.4	8.9	2.07	2.07	3.71	3.73	0.183
× 5	3.39	4.31	45	45	5	5.5	0	13.0	13.0	8.10	8.10	0.79	12.8	3.37	13.7	13.7	17.2	8.8	2.53	2.53	4.55	4.57	0.354
× 6	4.01	5.10	45	45	6	5.5	0	13.4	13.4	9.42	9.42	0.79	14.9	3.94	13.6	13.6	17.1	8.8	2.98	2.98	5.36	5.38	0.604
∠ 50 × 50 × 3	2.34	2.99	50	50	3	6.0	0	13.4	13.4	7.21	7.21	0.79	11.4	3.01	15.5	15.5	19.6	10.0	1.97	1.97	3.53	3.55	0.087
× 4	3.08	3.92	50	50	4	6.0	0	13.8	13.8	9.32	9.32	0.79	14.8	3.86	15.4	15.4	19.4	09.9	2.57	2.57	4.62	4.64	0.204
× 5	3.79	4.83	50	50	5	6.0	0	14.2	14.2	11.3	11.3	0.79	17.9	4.69	15.3	15.3	19.3	09.9	3.16	3.16	5.67	5.70	0.395
× 6	4.49	5.72	50	50	6	6.0	0	14.6	14.6	13.2	13.2	0.79	20.8	5.48	15.2	15.2	19.1	09.8	3.72	3.72	6.69	6.71	0.676
∠ 55 × 55 × 4	3.40	4.33	55	55	4	6.5	0	15.0	15.0	12.5	12.5	0.79	19.9	5.20	17.0	17.0	21.4	11.0	3.14	3.14	5.63	5.66	0.226
× 5	4.19	5.34	55	55	5	6.5	0	15.4	15.4	15.2	15.2	0.79	24.2	6.31	16.9	16.9	21.3	10.9	3.85	3.85	6.92	6.95	0.437
× 6	4.97	6.33	55	55	6	6.5	0	15.8	15.8	17.8	17.8	0.79	28.2	7.39	16.8	16.8	21.1	10.8	4.55	4.55	8.17	8.20	0.748
× 8	6.48	8.25	55	55	8	6.5	0	16.6	16.6	22.5	22.5	0.79	35.6	9.48	16.5	16.5	20.8	10.7	5.87	5.87	10.5	10.6	1.740
∠ 60 × 60 × 4	3.71	4.73	60	60	4	6.5	0	16.3	16.3	16.4	16.4	0.79	26.0	6.80	18.6	18.6	23.5	12.0	3.76	3.76	6.74	6.77	0.247
× 5	4.58	5.84	60	60	5	6.5	0	16.7	16.7	20.0	20.0	0.79	31.7	8.26	18.5	18.5	23.3	11.9	4.62	4.62	8.30	8.32	0.479
× 6	5.44	6.93	60	60	6	6.5	0	17.1	17.1	23.4	23.4	0.79	37.1	9.69	18.4	18.4	23.1	11.8	5.46	5.46	9.81	9.84	0.820
× 8	7.10	9.05	60	60	8	6.5	0	17.8	17.8	29.8	29.8	0.79	47.1	12.4	18.1	18.1	22.8	11.7	7.06	7.06	12.7	12.7	1.910
∠ 65 × 65 × 4	4.03	5.13	65	65	4	6.5	0	17.5	17.5	21.0	21.0	0.79	33.4	8.69	20.2	20.2	25.5	13.0	4.43	4.43	7.95	7.98	0.268
× 5	4.98	6.34	65	65	5	6.5	0	17.9	17.9	25.7	25.7	0.79	40.8	10.6	20.1	20.1	25.4	12.9	5.45	5.45	9.8	9.83	0.520
× 6	5.91	7.53	65	65	6	6.5	0	18.3	18.3	30.1	30.1	0.79	47.8	12.4	20.0	20.0	25.2	12.8	6.45	6.45	11.5	11.6	0.892
× 8	7.73	9.85	65	65	8	6.5	0	19.1	19.1	38.4	38.4	0.79	60.8	16.0	19.7	19.7	24.8	12.7	8.36	8.36	15.0	15.0	2.08

Table 9 (*Continued*)

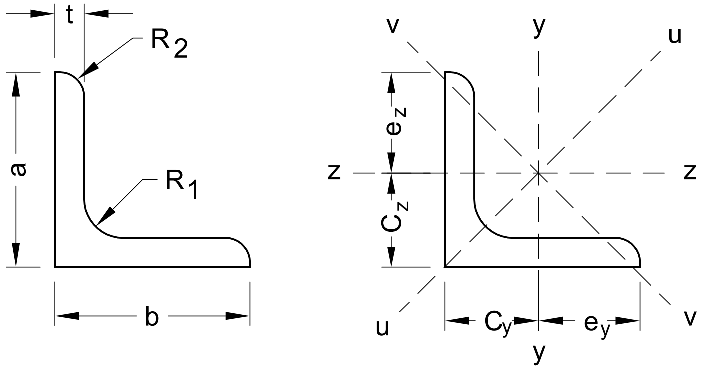
Designation	Mass M	Area A	Dimensions					Properties															
			a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times10^4$ mm^4	$\times10^4$ mm^4	rad	$\times10^4$ mm^4	$\times10^4$ mm^4	mm	mm	mm	mm	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 70 × 70 × 5	5.38	6.86	70	70	5	7.0	0	19.2	19.2	32.3	32.3	0.79	51.3	13.3	21.7	21.7	27.4	13.9	6.36	6.36	11.4	11.4	0.562
× 6	6.39	8.15	70	70	6	7.0	0	19.6	19.6	38.0	38.0	0.79	60.3	15.6	21.6	21.6	27.2	13.9	7.53	7.53	13.5	13.5	0.964
× 8	8.37	10.6	70	70	8	7.0	0	20.3	20.3	48.5	48.5	0.79	76.9	20.1	21.3	21.3	26.9	13.7	9.77	9.77	17.5	17.6	2.25
× 10	10.29	13.1	70	70	10	7.0	0	21.1	21.1	58.3	58.3	0.79	92.1	24.4	21.1	21.1	26.5	13.7	11.9	11.9	21.4	21.5	4.33
∠ 75 × 75 × 5	5.77	7.36	75	75	5	7.0	0	20.4	20.4	40.0	40.0	0.79	63.6	16.5	23.3	23.3	29.4	15.0	7.30	7.30	13.2	13.2	0.604
× 6	6.86	8.75	75	75	6	7.0	0	20.8	20.8	47.1	47.1	0.79	74.8	19.4	23.2	23.2	29.2	14.9	8.70	8.70	15.6	15.6	1.03
× 8	9.00	11.4	75	75	8	7.0	0	21.6	21.6	60.3	60.3	0.79	95.7	24.9	22.9	22.9	28.9	14.7	11.3	11.3	20.3	20.4	2.42
× 10	11.07	14.1	75	75	10	7.0	0	22.3	22.3	72.6	72.6	0.79	114	30.3	22.7	22.7	28.5	14.7	13.8	13.8	24.8	24.9	4.66
∠ 80 × 80 × 6	7.36	9.38	80	80	6	8.0	0	22.0	22.0	57.6	57.6	0.79	91.4	23.7	24.8	24.8	31.2	15.9	9.90	9.90	17.8	17.9	1.10
× 8	9.65	12.3	80	80	8	8.0	0	22.8	22.8	74.0	74.0	0.79	117	30.5	24.5	24.5	30.9	15.8	12.9	12.9	23.3	23.3	2.59
× 10	11.88	15.1	80	80	10	8.0	0	23.6	23.6	89.2	89.2	0.79	141	37.1	24.3	24.3	30.5	15.7	15.8	15.8	28.4	28.5	5.00
× 12	14.05	17.9	80	80	12	8.0	0	24.3	24.3	103	103	0.79	163	43.5	24.0	24.0	30.2	15.6	18.5	18.5	33.4	33.5	8.52
∠ 90 × 90 × 6	8.32	10.6	90	90	6	8.5	0	24.5	24.5	83.0	83.0	0.79	131	34.2	28.0	28.0	35.3	18.0	12.7	12.7	22.8	22.8	1.25
× 8	10.92	13.9	90	90	8	8.5	0	25.3	25.3	107	107	0.79	170	44.1	27.7	27.7	35.0	17.8	16.5	16.5	29.7	29.8	2.93
× 10	13.47	17.1	90	90	10	8.5	0	26.0	26.0	129	129	0.79	205	53.6	27.5	27.5	34.6	17.7	20.2	20.2	36.4	36.5	5.66
× 12	15.95	20.3	90	90	12	8.5	0	26.8	26.8	150	150	0.79	238	62.8	27.2	27.2	34.2	17.6	23.8	23.8	42.9	43.0	9.67
∠ 100 × 100 × 6	9.26	11.8	100	100	6	8.5	0	27.0	27.0	115	115	0.79	182	47.2	31.2	31.2	39.4	200	15.7	15.7	28.3	28.3	1.39
× 8	12.18	15.5	100	100	8	8.5	0	27.8	27.8	148	148	0.79	236	61	31	31	39	198	20.6	20.6	37	37.1	3.27
× 10	15.04	19.1	100	100	10	8.5	0	28.5	28.5	180	180	0.79	286	74.3	30.7	30.7	38.7	197	25.3	25.3	45.4	45.5	6.33
× 12	17.83	22.7	100	100	12	8.5	0	29.3	29.3	210	210	0.79	333	87.2	30.4	30.4	38.3	196	29.8	29.8	53.6	53.7	10.8
∠ 110 × 110 × 8	13.40	17.0	110	110	8	10.0	4.8	30.0	30.0	196	196	0.79	312	80.7	33.9	33.9	42.8	217	24.6	24.6	44.6	44.7	3.61
× 10	16.58	21.1	110	110	10	10.0	4.8	30.9	30.9	240	240	0.79	381	98.6	33.7	33.7	42.5	216	30.4	30.4	54.9	55	7.00
× 12	19.68	25.0	110	110	12	10.0	4.8	31.7	31.7	281	281	0.79	446	116	33.5	33.5	42.2	215	35.9	35.9	64.9	65.1	11.9
× 16	25.71	32.7	110	110	16	10.0	4.8	33.2	33.2	357	357	0.79	565	149	33	33	41.5	214	46.5	46.5	84.1	84.2	27.8

Table 9 (*Concluded*)

Designation	Mass M	Area A	Dimensions					Properties															
			a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 130 × 130 × 8	15.92	20.2	130	130	8	10.0	4.8	35.0	35.0	330	330	0.79	526	135	40.4	40.4	51	258	34.8	34.8	63	63.1	4.30
× 10	19.72	25.1	130	130	10	10.0	4.8	35.9	35.9	405	405	0.79	644	165	40.2	40.2	50.7	257	43.1	43.1	77.8	77.9	8.33
× 12	23.45	29.8	130	130	12	10.0	4.8	36.7	36.7	476	476	0.79	757	195	39.9	39.9	50.4	256	51	51	92.2	92.3	14.2
× 16	30.74	39.1	130	130	16	10.0	4.8	38.2	38.2	609	609	0.79	966	252	39.4	39.4	49.7	254	66.3	66.3	119	120	33.3
∠ 150 × 150 × 10	22.93	29.2	150	150	10	12.0	4.8	40.8	40.8	633	633	0.79	1 000	259	46.6	46.6	58.7	298	58	58	104	104	9.66
× 12	27.29	34.7	150	150	12	12.0	4.8	41.6	41.6	746	746	0.79	1 180	305	46.3	46.3	58.4	296	68.8	68.8	124	124	16.5
× 16	35.84	45.6	150	150	16	12.0	4.8	43.1	43.1	958	958	0.79	1 520	394	45.8	45.8	57.8	294	89.7	89.7	162	162	38.7
× 20	44.12	56.2	150	150	20	12.0	4.8	44.6	44.6	1 150	1 150	0.79	1 830	480	45.3	45.3	57.1	292	109	109	198	198	74.6
∠ 200 × 200 × 12	36.85	46.9	200	200	12	15.0	4.8	53.9	53.9	1 820	1 820	0.79	2 900	746	62.4	62.4	78.7	399	125	125	225	225	22.3
× 16	48.53	61.8	200	200	16	15.0	4.8	55.6	55.6	2 360	2 360	0.79	3 760	967	61.9	61.9	78	396	163	163	295	295	52.4
× 20	59.96	76.3	200	200	20	15.0	4.8	57.1	57.1	2 870	2 870	0.79	4 560	1 180	61.3	61.3	77.3	393	201	201	362	363	101
× 25	73.90	94.1	200	200	25	15.0	4.8	59.0	59.0	3 470	3 470	0.79	5 500	1 430	60.7	60.7	76.5	391	246	246	443	444	195

Table10 Supplementary List of Indian Standard Equal Leg Angles-Nominal Dimensions, Mass and Sectional Properties

(*Clauses* 4.1, 7.1 *and* 9.1)



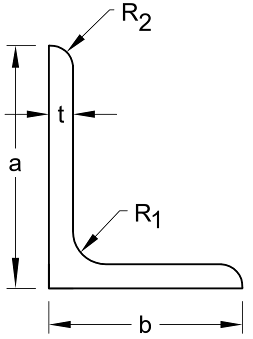
Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 50 × 50 × 7	5.17	6.59	50	50	7	6.0	0	15.0	15.0	14.9	14.9	0.79	23.6	6.27	15.1	15.1	18.9	9.8	4.26	4.26	7.67	7.7	1.06
× 8	5.84	7.44	50	50	8	6.0	0	15.4	15.4	16.6	16.6	0.79	26.2	7.03	14.9	14.9	18.8	9.7	4.79	4.79	8.62	8.65	1.57
∠ 55 × 55 × 10	7.92	10	55	55	10	6.5	0	17.3	17.3	26.8	26.8	0.79	42.1	11.5	16.3	16.3	20.4	10.7	7.11	7.11	12.8	12.8	3.33
∠ 60 × 60 × 10	8.71	11	60	60	10	6.5	0	18.6	18.6	35.5	35.5	0.79	55.9	15.1	17.9	17.9	22.5	11.7	8.57	8.57	15.4	15.4	3.66
∠ 65 × 65 × 10	9.49	12	65	65	10	6.5	0	19.8	19.8	45.9	45.9	0.79	72.5	19.4	19.5	19.5	24.5	12.7	10.1	10.1	18.3	18.3	4.00
∠ 70 × 70 × 7	7.39	9.42	70	70	7	7.0	0	20.0	20.0	43.4	43.4	0.79	68.8	17.9	21.5	21.5	27	13.8	8.66	8.66	15.5	15.6	1.52
∠ 100 × 100 × 7	10.73	13.6	100	100	7	8.5	0	27.4	27.4	132	132	0.79	210	54.2	31.1	31.1	39.2	19.9	18.2	18.2	32.7	32.7	2.2
× 15	21.91	27.9	100	100	15	8.5	0	30.4	30.4	252	252	0.79	398	106	30.1	30.1	37.8	19.5	36.2	36.2	65.3	65.4	20.8
∠ 120 × 120 × 8	14.66	18.6	120	120	8	10.0	4.8	32.5	32.5	258	258	0.79	410	105	37.2	37.2	46.9	23.8	29.5	29.5	53.4	53.5	3.95
× 10	18.15	23.1	120	120	10	10.0	4.8	33.4	33.4	315	315	0.79	501	129	36.9	36.9	46.6	23.6	36.4	36.4	65.9	66	7.66
× 12	21.57	27.4	120	120	12	10.0	4.8	34.2	34.2	370	370	0.79	588	152	36.7	36.7	46.3	23.5	43.1	43.1	78	78.1	13.1
× 15	26.58	33.8	120	120	15	10.0	4.8	35.3	35.3	447	447	0.79	709	185	36.4	36.4	45.8	23.4	52.8	52.8	95.5	95.6	25.3
∠ 130 × 130 × 9	17.82	22.7	130	130	9	10.0	4.8	35.5	35.5	368	368	0.79	586	150	40.3	40.3	50.8	25.7	39	39	70.5	70.6	6.09

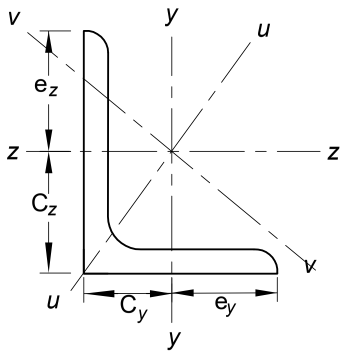
Table 10 (*Concluded*)

Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 150 × 150 × 15	33.72	42.9	150	150	15	12.0	4.8	42.8	42.8	907	907	0.79	1 440	372	46	46	57.9	29.5	84.6	84.6	152	152	32.0
× 18	40.01	50.9	150	150	18	12.0	4.8	43.9	43.9	1 050	1 050	0.79	1 680	437	45.6	45.6	57.4	29.3	99.8	99.8	180	180	54.8
∠ 180 × 180 × 15	41.09	52.3	180	180	15	18.0	4.8	50.0	50.0	1 610	1 610	0.79	2 550	663	55.5	55.5	69.9	35.6	123	123	223	223	38.8
× 18	48.79	62.1	180	180	18	18.0	4.8	51.2	51.2	1 880	1 880	0.79	2 990	778	55.1	55.1	69.4	35.4	146	146	264	264	66.4
× 20	53.85	68.6	180	180	20	18.0	4.8	52.0	52.0	2 060	2 060	0.79	3 270	853	54.9	54.9	69.1	35.3	161	161	290	291	90.6
∠ 200 × 200 × 24	71.31	90.8	200	200	24	18.0	4.8	58.5	58.5	3 350	3 350	0.79	5 320	1 390	60.8	60.8	76.5	39.1	237	237	427	428	173

Table 11 Nominal Dimensions, Mass and sectional Properties of Indian Standard Unequal Leg Angles

(*Clause* 4.1, 7.1 *and* 9.1)





Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu} (max)	I_{vv} (min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 30 × 20 × 3	1.14	1.45	30	20	3	4.5	0	9.9	5.1	1.29	0.46	1.05	1.47	0.27	9.4	5.6	10.1	4.3	0.64	0.31	1.16	0.56	0.042
× 4	1.48	1.88	30	20	4	4.5	0	10.4	5.5	1.63	0.57	0.40	1.85	0.34	9.3	5.5	9.9	4.3	0.83	0.39	1.48	0.73	0.098
× 5	1.80	2.29	30	20	5	4.5	0	10.7	5.8	1.93	0.67	0.39	2.19	0.41	9.2	5.4	9.8	4.2	1	0.47	1.79	0.9	0.187
∠ 40 × 25 × 3	1.50	1.91	40	25	3	5.0	0	13.2	5.9	3.11	0.94	0.37	3.48	0.57	12.7	7	13.5	5.4	1.16	0.49	2.08	0.9	0.055
× 4	1.96	2.49	40	25	4	5.0	0	13.6	6.3	3.97	1.19	0.36	4.44	0.72	12.6	6.9	13.3	5.4	1.5	0.64	2.69	1.18	0.130
× 5	2.40	3.05	40	25	5	5.0	0	14.0	6.7	4.76	1.42	0.36	5.31	0.87	12.5	6.8	13.2	5.3	1.83	0.77	3.27	1.45	0.250
× 6	2.82	3.59	40	25	6	5.0	0	14.4	7.0	5.50	1.62	0.35	6.1	1.02	12.4	6.7	13	5.3	2.15	0.9	3.81	1.72	0.424
∠ 45 × 30 × 3	1.74	2.21	45	30	3	5.0	0	14.4	7.1	4.57	1.65	0.41	5.26	0.96	14.4	8.6	15.4	6.6	1.49	0.72	2.7	1.29	0.064
× 4	2.27	2.89	45	30	4	5.0	0	14.8	7.4	5.87	2.10	0.41	6.75	1.22	14.2	8.5	15.3	6.5	1.95	0.93	3.5	1.69	0.151
× 5	2.79	3.55	45	30	5	5.0	0	15.2	7.8	7.08	2.51	0.40	8.11	1.48	14.1	8.4	15.1	6.4	2.38	1.13	4.27	2.08	0.291
× 6	3.29	4.19	45	30	6	5.0	0	15.6	8.2	8.21	2.89	0.40	9.37	1.73	14	8.3	14.9	6.4	2.79	1.32	5	2.46	0.496
∠ 50 × 30 × 3	1.86	2.37	50	30	3	5.5	0	16.4	6.7	6.13	1.69	0.35	6.79	1.03	16.1	8.4	16.9	6.6	1.83	0.73	3.28	1.31	0.069
× 4	2.44	3.10	50	30	4	5.5	0	16.9	7.1	7.89	2.15	0.34	8.73	1.32	15.9	8.3	16.8	6.5	2.38	0.94	4.26	1.72	0.162

Table 11 (*Continued*)

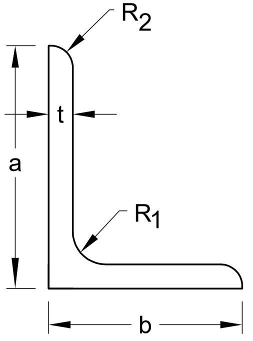
Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu} (max)	I_{vv} (min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times10^4$ mm^4	$\times10^4$ mm^4	rad	$\times10^4$ mm^4	$\times10^4$ mm^4	mm	mm	mm	mm	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
× 5	2.99	3.81	50	30	5	5.5	0	17.3	7.5	9.53	2.58	0.34	10.5	1.59	15.8	8.2	16.6	6.5	2.92	1.15	5.19	2.13	0.312
× 6	3.54	4.50	50	30	6	5.5	0	17.7	7.9	11.1	2.97	0.33	12.2	1.86	15.7	8.1	16.4	6.4	3.43	1.34	6.09	2.52	0.532
∠ 60 × 40 × 5	3.79	4.83	60	40	5	6.0	0	19.7	9.8	17.5	6.28	0.41	20.2	3.65	19.1	11.4	20.4	8.7	4.35	2.08	7.83	3.77	0.395
× 6	4.49	5.72	60	40	6	6.0	0	20.1	10.2	20.5	7.29	0.41	23.5	4.26	18.9	11.3	20.3	8.6	5.13	2.45	9.21	4.47	0.676
× 8	5.84	7.44	60	40	8	6.0	0	20.8	10.9	25.9	9.12	0.40	29.6	5.45	18.7	11.1	19.9	8.6	6.62	3.14	11.8	5.83	1.57
∠ 65 × 45 × 5	4.18	5.33	65	45	5	6.0	0	20.9	11.0	22.8	9.02	0.44	26.7	5.12	20.7	13	22.4	9.8	5.16	2.65	9.33	4.77	0.437
× 6	4.96	6.32	65	45	6	6.0	0	21.3	11.4	26.7	10.5	0.44	31.2	5.99	20.6	12.9	22.2	9.7	6.1	3.12	11	5.66	0.748
× 8	6.47	8.24	65	45	8	6.0	0	22.0	12.1	33.9	13.2	0.43	39.5	7.66	20.3	12.7	21.9	9.6	7.89	4.02	14.1	7.39	1.74
∠ 70 × 45 × 5	4.39	5.59	70	45	5	6.5	0	22.9	10.6	28.0	9.2	0.39	31.8	5.42	22.4	12.8	23.9	9.8	5.95	2.68	10.7	4.82	0.458
× 6	5.21	6.63	70	45	6	6.5	0	23.3	11.0	32.8	10.7	0.39	37.2	6.34	22.3	12.7	23.7	9.8	7.04	3.15	12.6	5.72	0.784
× 8	6.79	8.65	70	45	8	6.5	0	24.1	11.8	41.8	13.5	0.38	47.2	8.1	22	12.5	23.4	9.7	9.12	4.06	16.3	7.5	1.82
× 10	8.31	10.5	70	45	10	6.5	0	24.9	12.5	50.0	16.0	0.37	56.2	9.81	21.7	12.3	23	9.6	11.0	4.91	19.7	9.22	3.50
∠ 75 × 50 × 5	4.78	6.09	75	50	5	6.5	0	24.1	11.8	35.1	12.7	0.41	40.5	7.32	24	14.4	25.8	11.0	6.9	3.32	12.4	5.95	0.50
× 6	5.68	7.23	75	50	6	6.5	0	24.5	12.2	41.2	14.8	0.41	47.5	8.57	23.9	14.3	25.6	10.9	8.17	3.92	14.7	7.07	0.856
× 8	7.42	9.45	75	50	8	6.5	0	25.3	12.9	52.7	18.7	0.41	60.5	10.9	23.6	14.1	25.3	10.8	10.6	5.05	19	9.25	1.99
× 10	9.10	11.5	75	50	10	6.5	0	26.1	13.7	63.2	22.3	0.40	72.2	13.3	23.4	13.9	25.0	10.7	12.9	6.13	23.1	11.3	3.83
∠ 80 × 50 × 5	4.99	6.36	80	50	5	7.0	0	26.2	11.4	42	12.9	0.37	47.3	7.68	25.7	14.3	27.3	11.0	7.81	3.34	14.0	5.99	0.52
× 6	5.92	7.55	80	50	6	7.0	0	26.6	11.8	49.4	15.1	0.37	55.5	8.99	25.6	14.1	27.1	10.9	9.25	3.95	16.5	7.13	0.892
× 8	7.74	9.87	80	50	8	7.0	0	27.4	12.6	63.2	19.1	0.37	70.8	11.5	25.3	13.9	26.8	10.8	12.0	5.09	21.4	9.36	2.08
× 10	9.50	12.1	80	50	10	7.0	0	28.2	13.3	76	22.7	0.36	84.7	13.9	25	13.7	26.5	10.7	14.6	6.18	26.0	11.5	4.00
∠ 90 × 60 × 6	6.88	8.76	90	60	6	7.5	0	29.0	14.2	72.8	26.3	0.41	84.0	15.2	28.8	17.3	31.0	13.2	11.9	5.74	21.5	10.2	1.03
× 8	9.01	11.4	90	60	8	7.5	0	29.8	14.9	93.6	33.5	0.41	107	19.5	28.6	17.1	30.6	13.0	15.5	7.44	27.9	13.4	2.42
× 10	11.08	14.1	90	60	10	7.5	0	30.6	15.7	113	40.1	0.41	129	23.6	28.3	16.9	30.3	12.9	19.0	9.05	34.1	16.6	4.66
× 12	13.09	16.6	90	60	12	7.5	0	31.3	16.4	131	46.2	0.40	149	27.6	28	16.6	30.0	12.9	22.3	10.6	39.9	19.7	7.94

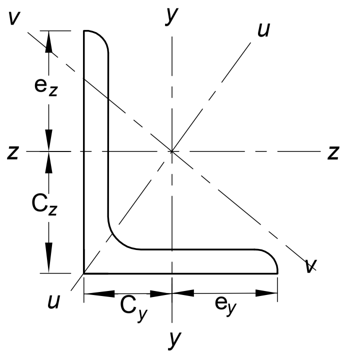
Table 11 (*Concluded*)

Designation	Mass	Area	Dimensions					Properties															
	M	*A*	*a*	*b*	*t*	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu} (max)	I_{vv} (min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 100 × 65 × 6	7.60	9.68	100	65	6	8.0	0	32.2	15.0	100	34	0.40	114	19.8	32.2	18.8	34.4	14.3	14.8	6.80	26.6	12.1	1.14
× 8	9.97	12.7	100	65	8	8.0	0	33.0	15.7	129	43.5	0.40	147	25.5	31.9	18.5	34.0	14.2	19.3	8.80	34.6	15.9	2.67
× 10	12.28	15.6	100	65	10	8.0	0	33.8	16.5	156	52.2	0.39	177	30.9	31.6	18.3	33.7	14.0	23.6	10.8	42.3	19.7	5.16
∠ 100 × 75 × 6	8.08	10.3	100	75	6	8.5	0	30.5	18.2	105	51.2	0.50	128	27.6	31.9	22.3	35.4	16.4	15.1	9.00	27.4	16.0	1.21
× 8	10.61	13.5	100	75	8	8.5	0	31.3	18.9	135	65.7	0.50	165	35.5	31.7	22.1	35.0	16.2	19.7	11.7	35.8	21.0	2.85
× 10	13.07	16.6	100	75	10	8.5	0	32.1	19.7	164	79.2	0.50	200	43.0	31.4	21.8	34.7	16.1	24.2	14.3	43.8	25.9	5.50
× 12	15.48	19.7	100	75	12	8.5	0	32.8	20.4	191	91.7	0.50	232	50.4	31.1	21.6	34.3	16.0	28.5	16.8	51.4	30.6	9.38
∠ 125 × 75 × 6	9.27	11.8	125	75	6	9.0	0	40.8	16.2	194	54.3	0.35	215	32.7	40.5	21.4	42.7	16.6	23.1	9.20	41.3	16.4	1.39
× 8	12.19	15.5	125	75	8	9.0	0	41.7	17.0	251	69.7	0.35	279	42.1	40.3	21.2	42.4	16.5	30.2	12.0	53.9	21.6	3.27
× 10	15.05	19.1	125	75	10	9.0	0	42.6	17.8	306	84.1	0.35	339	51.0	40.0	20.9	42.1	16.3	37.2	14.7	66.2	26.7	6.33
∠ 125 × 95 × 6	10.14	12.9	125	95	6	9.0	4.8	37.2	22.4	205	103	0.52	254	55.0	39.9	28.3	44.4	20.6	23.4	14.3	42.9	25.5	1.54
× 8	13.37	17.0	125	95	8	9.0	4.8	38.0	23.2	268	134	0.52	331	71.4	39.7	28.1	44.1	20.5	30.9	18.8	56.4	33.7	3.61
× 10	16.54	21.0	125	95	10	9.0	4.8	38.9	24.0	328	164	0.51	404	87.3	39.4	27.9	43.8	20.4	38.1	23.1	69.4	41.7	7.00
× 12	19.65	25.0	125	95	12	9.0	4.8	39.7	24.8	384	191	0.51	473	102	39.2	27.7	43.5	20.2	45.1	27.3	82.0	49.5	11.9
∠ 150 × 115 × 8	16.27	20.7	150	115	8	11.0	4.8	44.8	27.6	474	244	0.52	589	128	47.8	34.3	53.4	24.9	45.1	27.9	82.4	50	4.38
× 10	20.14	25.6	150	115	10	11.0	4.8	45.7	28.4	581	298	0.52	722	157	47.6	34.1	53.1	24.8	55.8	34.5	101	61.9	8.50
× 12	23.96	30.5	150	115	12	11.0	4.8	46.5	29.2	684	350	0.52	849	185	47.4	33.9	52.8	24.7	66.2	40.8	120	73.5	14.5
× 16	31.40	40	150	115	16	11.0	4.8	48.1	30.7	878	446	0.52	1 080	239	46.9	33.4	52.1	24.4	86.2	53	156	96.1	33.9
∠ 200 × 100 × 10	22.93	29.2	200	100	10	12.0	4.8	69.8	20.3	1 220	214	0.26	1 300	137	64.8	27.1	66.8	21.7	94.3	26.9	165	48.7	9.66
× 12	27.29	34.7	200	100	12	12.0	4.8	70.7	21.1	1 440	251	0.26	1 530	161	646	26.9	66.5	21.5	112	31.9	196	58.3	16.5
× 16	35.84	45.6	200	100	16	12.0	4.8	72.3	22.7	1 870	319	0.25	1 980	207	64	26.5	65.9	21.3	146	41.3	255	77.5	38.7
∠ 200 × 150 × 10	26.92	34.2	200	150	10	13.5	4.8	60.2	35.5	1 400	688	0.51	1 720	368	64.1	44.8	71	32.8	100	60.2	183	107	11.3
× 12	32.07	40.8	200	150	12	13.5	4.8	61.1	36.3	1 660	812	0.51	2 040	433	63.9	44.6	70.7	32.6	119	71.4	218	127	19.4
× 16	42.18	53.7	200	150	16	13.5	4.8	62.7	37.9	2 150	1 040	0.5	2 630	560	63.3	44.1	70.1	32.3	156	93.2	285	167	45.6
× 20	52.04	66.2	200	150	20	13.5	4.8	64.2	39.4	2 610	1 260	0.5	3 190	682	62.8	43.6	69.4	32.1	192	114	349	206	88.0

Table 12 Supplementary List of Indian Standard Unequal Leg Angles-Nominal Dimensions, Mass and Sectional Properties

(*Clauses* 4.1, 7.1 *and* 9.1)





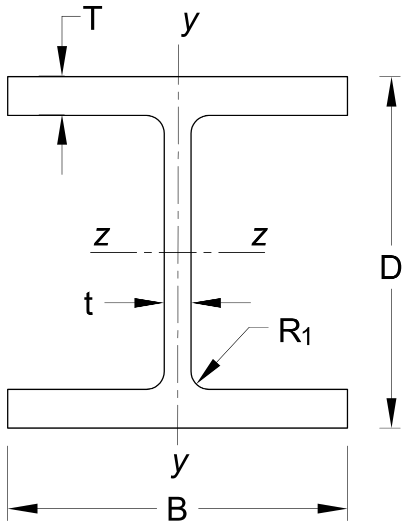
Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
∠ 40 × 20 × 3	1.37	1.74	40	20	3	4.0	0	14.3	4.5	2.9	0.49	0.25	3.04	0.32	12.8	5.3	13.2	4.3	1.11	0.32	1.95	0.59	0.051
× 4	1.79	2.27	40	20	4	4.0	0	14.7	4.9	3.7	0.62	0.25	3.86	0.41	12.7	5.2	13.0	4.2	1.45	0.41	2.52	0.78	0.119
× 5	2.19	2.78	40	20	5	4.0	0	15.1	5.2	4.4	0.73	0.24	4.62	0.49	12.5	5.1	12.9	4.2	1.76	0.49	3.05	0.97	0.229
∠ 60 × 30 × 5	3.40	4.33	60	30	5	6.0	0	21.6	6.9	15.9	2.70	0.25	16.8	1.76	19.2	7.9	19.7	6.4	4.14	1.17	7.24	2.21	0.354
× 6	4.02	5.12	60	30	6	6.0	0	22.1	7.3	18.5	3.11	0.25	19.6	2.06	19	7.8	19.6	6.3	4.88	1.37	8.50	2.64	0.604
∠ 60 × 40 × 7	5.17	6.59	60	40	7	6.0	0	20.5	10.6	23.3	8.23	0.40	26.6	4.86	18.8	11.2	20.1	8.6	5.89	2.80	10.5	5.16	1.06
∠ 65 × 50 × 5	4.38	5.58	65	50	5	6.0	0	20.0	12.6	23.6	12.2	0.52	29.3	6.48	20.6	14.8	22.9	10.8	5.25	3.27	9.53	5.85	0.458
× 6	5.19	6.62	65	50	6	6.0	0	20.4	13.0	27.6	14.2	0.52	34.3	7.59	20.4	14.7	22.8	10.7	6.20	3.85	11.2	6.93	0.784
× 7	6.00	7.64	65	50	7	6.0	0	20.8	13.4	31.5	16.2	0.52	39.0	8.67	20.3	14.5	22.6	10.7	7.13	4.42	12.9	7.99	1.23
× 8	6.78	8.64	65	50	8	6.0	0	21.2	13.8	35.2	18.0	0.52	43.4	9.72	20.2	14.4	22.4	10.6	8.03	4.97	14.5	9.03	1.82
∠ 70 × 50 × 5	4.57	5.83	70	50	5	6.0	0	22.1	12.2	29.0	12.5	0.46	34.5	6.92	22.3	14.6	24.3	10.9	6.05	3.30	10.9	5.90	0.479
× 6	5.43	6.92	70	50	6	6.0	0	22.5	12.6	34.0	14.5	0.46	40.4	8.11	22.2	14.5	24.2	10.8	7.16	3.89	12.9	7.00	0.82
× 7	6.27	7.99	70	50	7	6.0	0	22.9	13.0	38.8	16.5	0.46	46.0	9.26	22.0	14.4	24.0	10.8	8.23	4.46	14.8	8.08	1.29
× 8	7.09	9.04	70	50	8	6.0	0	23.3	13.3	43.4	18.4	0.46	51.4	10.3	21.9	14.3	23.8	10.7	9.28	5.01	16.7	9.14	1.91
∠ 75 × 50 × 7	6.57	8.37	75	50	7	7.0	0	24.9	12.6	47.1	16.8	0.41	54.2	9.80	23.7	14.2	25.4	10.8	9.41	4.49	16.9	8.17	1.34
∠ 80 × 40 × 5	4.60	5.86	80	40	5	7.0	0	28.2	8.6	39.0	6.74	0.26	41.4	4.36	25.8	10.7	26.6	8.6	7.53	2.14	13.1	3.94	0.479
× 6	5.45	6.95	80	40	6	7.0	0	28.6	8.9	45.7	7.84	0.25	48.5	5.09	25.7	10.6	26.4	8.6	8.90	2.52	15.5	4.70	0.82

Table 12 (*Concluded*)

Designation	Mass	Area	Dimensions					Properties															
	M	A	a	b	t	R_1	R_2	C_y	C_z	I_{zz}	I_{yy}	α	I_{uu}(max)	I_{vv}(min)	r_z	r_y	r_u	r_v	Z_z	Z_y	Z_{pz}	Z_{py}	I_t
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	mm	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	rad	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
× 7	6.29	8.02	80	40	7	7.0	0	29.1	9.3	52.2	8.87	0.25	55.3	5.80	25.5	10.5	26.3	8.5	10.2	2.89	17.8	5.47	1.29
× 8	7.12	9.07	80	40	8	7.0	0	29.5	9.7	58.4	9.84	0.25	61.7	6.50	25.4	10.4	26.1	8.5	11.5	3.25	20.1	6.24	1.91
∠ 80 × 60 × 6	6.42	8.18	80	60	6	8.0	0	24.8	15.0	52.6	25.5	0.50	64.3	13.8	25.4	17.7	28.0	13.0	9.50	5.70	17.3	10.1	0.964
× 7	7.42	9.45	80	60	7	8.0	0	25.2	15.4	60.1	29.1	0.50	73.4	15.8	25.2	17.5	27.9	12.9	11.0	6.50	19.9	11.7	1.52
× 8	8.40	10.7	80	60	8	8.0	0	25.6	15.7	67.4	32.5	0.50	82.2	17.7	25.1	17.4	27.7	12.9	12.4	7.30	22.4	13.3	2.25
∠ 90 × 65 × 6	7.13	9.08	90	65	6	8.0	0	28.1	15.7	74.8	33.1	0.47	89.7	18.3	28.7	19.1	31.4	14.2	12.1	6.70	21.9	12.0	1.07
× 7	8.24	10.5	90	65	7	8.0	0	28.5	16.1	85.7	37.8	0.47	102	20.9	28.6	19.0	31.3	14.1	13.9	7.70	25.2	13.9	1.69
× 8	9.34	11.9	90	65	8	8.0	0	28.9	16.5	96.3	42.3	0.47	115	23.5	28.4	18.9	31.1	14.0	15.8	8.70	28.5	15.7	2.50
× 10	11.49	14.6	90	65	10	8.0	0	29.7	17.3	116	50.7	0.47	138	28.4	28.2	18.6	30.8	13.9	19.3	10.6	34.8	19.3	4.83
∠ 100 × 50 × 6	6.92	8.81	100	50	6	9.0	0	35.1	10.6	91.9	15.9	0.26	97.5	10.3	32.3	13.4	33.3	10.8	14.2	4	24.8	7.4	1.03
× 7	7.99	10.1	100	50	7	9.0	0	35.6	11.0	105	18.1	0.26	111	11.7	32.1	13.3	33.1	10.7	16.3	4.6	28.6	8.6	1.63
× 8	9.05	11.5	100	50	8	9.0	0	36.0	11.4	118	20.2	0.25	125	13.1	32	13.2	32.9	10.7	18.5	5.2	32.2	9.8	2.42
10.00	11.13	14.1	100	50	10	9.0	0	36.8	12.1	142	24	0.25	150	15.9	31.7	13	32.6	10.6	22.6	6.3	39.3	12.2	4.66
∠ 100 × 65 × 7	8.85	11.2	100	65	7	10.0	0	32.5	15.3	115	38.9	0.40	131	22.8	32	18.6	34.1	14.2	17.1	7.8	30.7	14.1	1.80
∠ 120 × 80 × 8	12.26	15.6	120	80	8	11.0	0	38.5	18.9	230	83.2	0.41	265	48.1	38.4	23.1	41.2	17.5	28.3	13.6	51.0	24.4	3.27
× 10	15.12	19.2	120	80	10	11.0	0	39.4	19.6	280	100	0.41	322	58.3	38.1	22.8	40.9	17.4	34.8	16.6	62.6	30.1	6.33
× 12	17.91	22.8	120	80	12	11.0	0	40.2	20.4	327	116	0.41	375	68.1	37.9	22.6	40.6	17.3	41.0	19.6	73.7	35.7	10.8
∠ 125 × 75 × 12	17.91	22.8	125	75	12	11.0	0	43.2	18.5	358	97.5	0.34	396	59.8	39.7	20.7	41.7	16.2	43.9	17.3	78.1	31.8	10.8
∠ 135 × 65 × 8	12.18	15.5	135	65	8	11.0	4.8	47.9	13.5	292	45.5	0.24	308	29.7	43.4	17.1	44.6	13.8	33.6	8.8	59	16.4	3.27
× 10	15.04	19.1	135	65	10	11.0	4.8	48.8	14.3	357	55.0	0.24	376	36.1	43.2	16.9	44.3	13.7	41.4	10.8	72.5	20.5	6.33
× 12	17.84	22.7	135	65	12	11.0	4.8	49.7	15.1	418	63.9	0.24	440	42.3	42.9	16.8	44	13.6	49	12.8	85.4	24.6	10.8
∠ 150 × 75 × 9	15.39	19.6	150	75	9	11.0	4.8	52.8	15.8	457	78.8	0.26	485	50.7	48.3	20.1	49.8	16.1	47.1	13.3	82.8	24.5	5.24
× 15	24.85	31.6	150	75	15	11.0	4.8	55.3	18.1	715	120	0.25	755	79.1	47.5	19.5	48.9	15.8	75.5	21.1	131	40.7	23.6
∠ 150 × 90 × 10	18.22	23.2	150	90	10	12.0	4.8	50.0	20.4	536	147	0.35	594	89.1	48.1	25.2	50.6	19.6	53.6	21.2	96.2	38.4	7.66
× 12	21.64	27.5	150	90	12	12.0	4.8	50.9	21.2	630	172	0.34	698	104	47.8	25	50.3	19.5	63.6	25	113	45.8	13.1
× 15	26.66	33.9	150	90	15	12.0	4.8	52.1	22.4	764	206	0.34	843	126	47.4	24.7	49.8	19.3	78	30.6	139	56.7	25.3
∠ 200 × 100 × 15	33.86	43.1	200	100	15	15.0	4.8	71.7	22.3	1 770	303	0.25	1 870	196	64.1	26.5	66	21.3	138	39	241	72.9	32.0
∠ 200 × 150 × 15	39.75	50.6	200	150	15	15.0	4.8	62.2	37.5	2 030	988	0.50	2 490	530	63.4	44.2	70.2	32.4	147	87.8	268	157	37.6
× 18	47.21	60.1	200	150	18	15.0	4.8	63.4	38.6	2 390	1 150	0.50	2 920	623	63.0	43.8	69.7	32.2	175	103	317	187	64.5

Table 13 Indian Standard Parallel Flange Bearing Piles

(*Clauses* 4.1, 7.1 *and* 9.1)



Designation	Mass	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times 10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times 10^4$ mm^4	$\times 10^4$ mm^4	mm	mm	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^3$ mm^3	$\times 10^4$ mm^4	$\times 10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
PBP 200 ×	43.85	55.8	200	205	9.3	9.3	90.0	10.0	0.0	3 990	1 330	84.6	4.89	399	130	447	199	17.9	121 000
PBP 200 ×	53.49	68.1	204	207	11.3	11.3	90.0	10.0	0.0	4 970	1 670	85.4	4.96	487	161	551	248	31.9	155 000
PBP 220 ×	57.28	72.9	210	225	11.0	11.0	90.0	18.0	0.0	5 730	2 090	88.7	5.36	546	186	614	286	37.6	206 000
PBP 260 ×	75.01	95.5	249	265	12.0	12.0	90.0	24.0	0.0	10 600	3 730	105	6.25	854	281	958	435	64.3	522 000
PBP 260 ×	87.30	111	253	267	14.0	14.0	90.0	24.0	0.0	12 500	4 450	106	6.33	993	333	1 120	516	96.6	634 000
PBP 300 ×	76.92	97.9	299	306	10.8	10.8	90.0	15.0	0.0	16 000	5 160	127	7.26	1 070	337	1 180	515	43.5	1 070 000
PBP 300 ×	88.46	112	302	308	12.4	12.4	90.0	15.0	0.0	18 500	6 040	128	7.32	1 220	392	1 370	600	65	1 260 000
PBP 300 ×	95.00	121	304	309	13.3	13.3	90.0	15.0	0.0	20 000	6 540	128	7.36	1 320	423	1 470	649	79.8	1 380 000
PBP 300 ×	109.54	139	308	311	15.3	15.3	90.0	15.0	0.0	23 400	7 680	129	7.42	1 520	494	1 710	758	120	1 640 000

Table 13 (*Concluded*)

Designation	Mass	Area	Dimensions							Properties									
	M	A	D	B	t	T	Flange Slope	R_1	R_2	I_{zz}	I_{yy}	r_z	r_y	Z_{zz}	Z_{yy}	Z_{pz}	Z_{py}	I_t	I_w
	kg/m	$\times10^2$ mm^2	mm	mm	mm	mm	degree	mm	mm	$\times10^4$ mm^4	$\times10^4$ mm^4	mm	mm	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^3$ mm^3	$\times10^4$ mm^4	$\times10^6$ mm^6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
PBP 300 ×	124.20	158	312	313	17.3	17.3	90.0	15.0	0.0	26 900	8 850	130	7.48	1 720	565	1 950	870	173	1 910 000
PBP 300 ×	150.01	191	319	316	20.8	20.8	90.0	15.0	0.0	33 200	10 900	132	7.57	2 080	693	2 380	1 070	300	2 430 000
PBP 300 ×	180.12	229	327	320	24.8	24.8	90.0	15.0	0.0	41 000	13 500	133	7.69	2 500	849	2 900	1 310	510	3 090 000
PBP 300 ×	184.12	234	328	321	25.3	25.3	90.0	15.0	0.0	42 000	13 900	133	7.72	2 560	871	2 970	1 350	542	3 190 000
PBP 300 ×	222.58	283	338	326	30.3	30.3	90.0	15.0	0.0	52 500	17 500	136	7.87	3 100	1 070	3 640	1 670	936	4 140 000
PBP 320 ×	88.48	112	303	304	12.0	12.0	90.0	27.0	0.0	18 700	5 630	128	7.07	1 230	370	1 370	572	78.8	1 180 000
PBP 320 ×	102.84	131	307	306	14.0	14.0	90.0	27.0	0.0	22 000	6 700	129	7.15	1 430	438	1 610	677	117	1 430 000
PBP 320 ×	117.33	149	311	308	16.0	16.0	90.0	27.0	0.0	25 400	7 810	130	7.23	1 630	507	1 840	785	167	1 690 000
PBP 320 ×	146.69	186	319	312	20.0	20.0	90.0	27.0	0.0	32 600	10 100	132	7.37	2 040	651	2 330	1 010	309	2 260 000
PBP 320 ×	184.10	234	329	317	25.0	25.0	90.0	27.0	0.0	42 200	13 300	134	7.54	2 560	841	2 970	1 310	586	3 060 000
PBP 360 ×	152.2	193	356	376	18	17.9	90.0	15	0	43 800	15 800	150	9	2 460	844	2 760	1 290	225	4 530 000
PBP 360 ×	174.2	221	361	379	20	20.4	90.0	15	0	50 900	18 500	151	9.1	2 820	978	3 180	1 500	325	5 360 000
PBP 360 ×	178.4	227	362	379	21	20.9	90.0	15	0	52 200	18 900	152	9.1	2 880	1 000	3 260	1 530	357	5 510 000
PBP 400 ×	122.4	155	348	390	14	14	90.0	15	0	34 700	13 800	149	9.4	1 990	710	2 210	1 080	111	3 860 000
PBP 400 ×	140.2	178	352	392	16	16	90.0	15	0	40 200	16 000	150	9.5	2 280	820	2 540	1 250	165	4 530 000
PBP 400 ×	158.1	201	356	394	18	18	90.0	15	0	45 900	18 300	151	9.6	2 570	932	2 880	1 420	234	5 240 000
PBP 400 ×	176.1	224	360	396	20	20	90.0	15	0	51 700	20 700	152	9.6	2 870	1 040	3 230	1 600	321	5 980 000
PBP 400 ×	194.3	247	364	398	22	22	90.0	15	0	57 600	23 100	153	9.7	3 160	1 160	3 580	1 780	428	6 750 000
PBP 400 ×	212.5	270	368	400	24	24	90.0	15	0	63 800	25 600	154	9.7	3 460	1 280	3 940	1 960	556	7 570 000
PBP 400 ×	230.9	294	372	402	26	26	90.0	15	0	70 100	28 200	154	9.8	3 770	1 400	4 310	2 150	707	8 420 000

ANNEX A

(*Foreward and Clause* 9.2)

FORMULAE TO CALCULATE THE GEOMETRICAL SECTIONAL PROPERTIES

A-1 To calculate the sectional properties of the I-Sections, channel sections and angles sections, the formulae given in Table 14, Table 15 and Table 16 may be used.

Table 14 I-Sections

(*Clause* A-1)

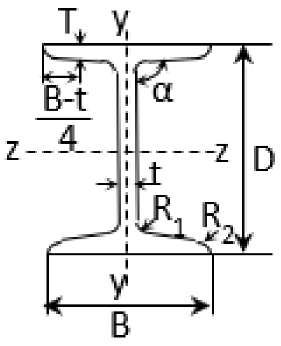
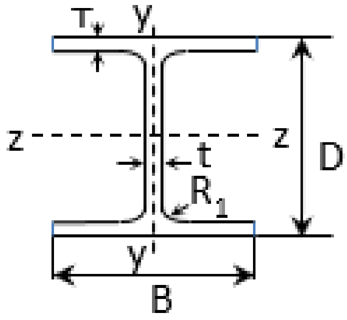
Detail	**Sections with Non-Parallel Flanges**	**Sections with parallel flanges**
Section	$\theta = (\alpha - 90)\frac{\pi}{180} \qquad T_2 = T - \frac{1}{4}(B - t)\tan\theta$ $A_t = R_2^2\left[\tan\theta - \left(\frac{0.25 - \theta}{2}\right)\right] \qquad A_r = R_1^2\left[\tan\theta - \left(\frac{0.25 - \theta}{2}\right)\right]$ $Y_t = \frac{D}{2} - T_2 + R_2\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) - R_2\left\{\frac{\frac{1}{6}\tan^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)(1 - \sin\theta) + \frac{1}{3}\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\theta - \frac{2}{3}\sin^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)}{\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \left(\frac{\pi}{4} - \frac{\theta}{2}\right)}\right\}$ $Y_r = \frac{D}{2} - T_1 - R_1\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) + R_1\left\{\frac{\frac{1}{6}\tan^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)(1 - \sin\theta) + \frac{1}{3}\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\theta - \frac{2}{3}\sin^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)}{\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \left(\frac{\pi}{4} - \frac{\theta}{2}\right)}\right\}$ $Z_t = \frac{B}{2} - R_2\left\{\frac{\frac{1}{3}\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right)(2 - \sin\theta) - \frac{1}{6}\tan^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\theta - \left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \frac{2}{3}\sin\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\left(\frac{\pi}{4} - \frac{\theta}{2}\right)}{\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \left(\frac{\pi}{4} - \frac{\theta}{2}\right)}\right\}$ $Z_r = \frac{T}{2} + R_1\left\{\frac{\frac{1}{3}\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right)(2 - \sin\theta) - \frac{1}{6}\tan^2\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\theta - \left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \frac{2}{3}\sin\left(\frac{\pi}{4} - \frac{\theta}{2}\right)\cos\left(\frac{\pi}{4} - \frac{\theta}{2}\right)}{\tan\left(\frac{\pi}{4} - \frac{\theta}{2}\right) - \left(\frac{\pi}{4} - \frac{\theta}{2}\right)}\right\}$  T y B-t / 4 α z z D t R1 R2 y B	

Table 14 (*Continued*)

	Exact Formula	**Approximate Formula**	**Approximate formula**
Area (A)	$A = B \times D - (D - 2T)(B - t) - 4A_t + 4A_r$	$A = B \times D - (D - 2T)(B - t)$	$A = B \times D - (D - 2T)(B - t)$
Moment of Inertia	$I_{zz} = \frac{1}{12}BD^3 - \frac{1}{12}(B-t)(D-2T_2)^3 + (T_1-T_2)\left(\frac{D}{2} - \frac{T_1}{3} - \frac{2T_2}{3}\right)^2 - 4A_t y_t^2 + 4A_r y_r^2$ $I_{yy} = \frac{1}{6}T_2B^3 + \frac{1}{24}(T_2-T_1)^3 + \frac{1}{12}(D-2T_1)t^3 - 4A_tZ_t^2 + 4A_rZ_r^2$	$I_{zz} = \frac{1}{12}BD^3 - \frac{1}{12}(B-t)(D-2T_2)^3 + (T_1-T_2)$ $\left(\frac{D}{2} - \frac{T_1}{3} - \frac{2T_2}{3}\right)^2$ $I_{yy} = \frac{1}{6}T_2B^3 + \frac{1}{24}(T_2-T_1)^3 + \frac{1}{12}(D-2T_1)t^3$	$I_{zz} = BD^3 - (B - t)(D - 2 \times T)^3$ $I_{yy} = \frac{1}{6}TB^3 + \frac{1}{12}(D-2T)t^3$
Radius of Gyration	$R_{zz} = \sqrt{\frac{I_{zz}}{A}}$; $R_{yy} = \sqrt{\frac{I_{yy}}{A}}$	$R_{zz} = \sqrt{\frac{I_{zz}}{A}}$; $R_{yy} = \sqrt{\frac{I_{yy}}{A}}$	$R_{zz} = \sqrt{\frac{I_{zz}}{A}}$; $R_{yy} = \sqrt{\frac{I_{yy}}{A}}$
Elastic Section Moduli	$Z_{zz} = 2I_{zz}/D$; $Z_{yy} = 2I_{yy}/B$	$Z_{zz} = 2I_{zz}/D$; $Z_{yy} = 2I_{yy}/B$	$Z_{zz} = 2I_{zz}/D$; $Z_{yy} = 2I_{yy}/B$
Plastic Section Moduli	$Z_{pz} = \frac{1}{4}BD^2 - (B-t)\left[\frac{1}{4}(D-2T_2)^2 + (T_1-T_2)\left(\frac{D}{2} - \frac{T_1}{3} - \frac{2T_2}{3}\right)\right] - 4A_t y_t + 4A_r Y_r$ $Z_{py} = \frac{1}{2}T_2B^2 + \frac{1}{3}(T_1-T_2)B^2 + \frac{1}{4}(D-2T_1)t^2 - 4A_t z_t + 4A_r z_r$	$Z_{pz} = \frac{1}{4}BD^2 - (B-t)$ $\left[\frac{1}{4}(D-2T_2)^2 + (T_1-T_2)\left(\frac{D}{2} - \frac{1}{3}T_1 - \frac{2}{3}T_2\right)\right]$ $Z_{py} = \frac{1}{2}T_2B^2 + \frac{1}{3}(T_1-T_2)B^2 + \frac{1}{4}(D-2T_1)t^2$	$Z_{pz} = \frac{1}{4}BD^2 - \frac{1}{4}(B-t)(D-2T)^2$ $Z_{py} = \frac{1}{2}TB^2 + \frac{1}{4}(D-2T)t^2$

Table 14 (*Concluded*)

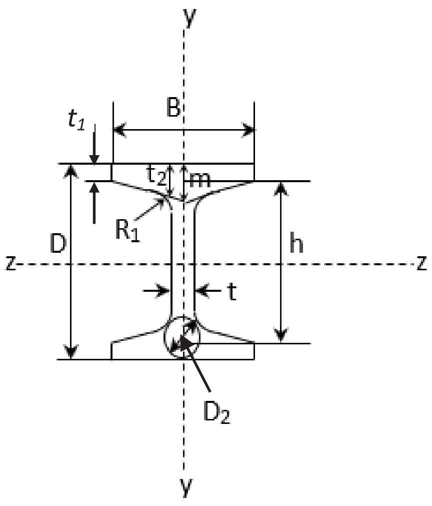
	Exact Formula	**Approximate Formula**	**Approximate formula**
Torsional rigidity	**Approximate Formula:** $I_t = \frac{1}{6}(B-t)(t_1+t_2)(t_1^2+t_2^2)+\frac{2}{3}t\,t_2^3+\frac{1}{3}(D-2t_2)t^3+2\alpha_2\,D_2^4-4V_s\,t_1^4$ *For* 0% *flange slope,* $\alpha_2 = -0.0420+0.220\frac{t}{T}+0.136\left(\frac{R_1}{t}\right)-0.0865\left(\frac{t\,R_1}{T^2}\right)-0.0725\left(\frac{t_2}{T}\right)^2$ *For* 16 $\frac{2}{3}$ % *flange slope,* $\alpha_2 = -0.0836+0.254\left(\frac{t}{t_2}\right)+0.127\left(\frac{R_1}{t_2}\right)-0.0806\left(\frac{t\,R_1}{t_2^2}\right)-0.0858\left(\frac{t}{t_2^2}\right)^2$ *For other flange slopes the* α_2 *value may be found by linear interpolation* *S* = 2 × (*m* – *t*)/*B* $F = R_1\,S\left[\left(1+S^{-2}\right)^{0.5}-1-\left(\frac{t}{2R_1}\right)\right]$ $D_2 = \frac{\left[\left(F+m\right)^2+\left(\frac{t}{R_1+t/4}\right)\right]}{\left(F+R_1+m\right)}$ $V_s = 0.105+0.100\,S+0.0848\,S^2+0.0675\,S^3+0.0515\,S^4$	 y B t1 t2 m R1 D h z z t D2 y	$I_t = \frac{2}{3}BT^3+\frac{1}{3}(D-2T)t^3+$ $2\alpha_1 D_1^4-0.42T^4$ $D_1 = \frac{\left[(t+R_1)^2+t\left(R_1+t/4\right)\right]}{\left(2R_1+T\right)}$

Table 15 Channel Sections

(*Clause* A-1)

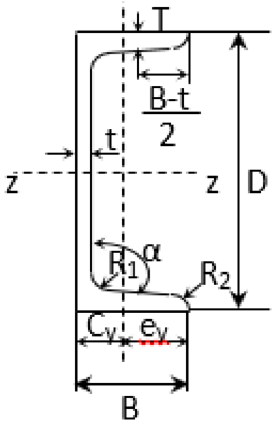
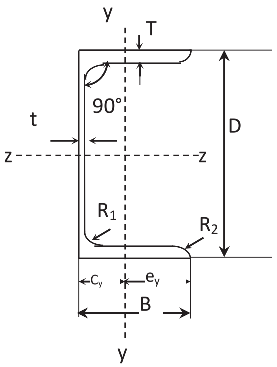
Section	$\theta=(\alpha-90)\times\frac{\pi}{90}$; $T_1=T+0.25\,x(B-t)\tan\theta$ $T_1=T-0.25\,x(B-t)\tan\theta$ $A_t=R_2^2\left[\tan\theta-\left(\frac{0.25-\theta}{2}\right)\right]$; $A_r=R_1^2\left[\tan\theta-\left(\frac{0.25-\theta}{2}\right)\right]$ $Y_t=\frac{D}{2}-T_2+R_2\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-R_2\left\{\frac{\left(\frac{1}{6}\tan^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)(1-\sin\theta)+\frac{1}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\theta-\frac{2}{3}\sin^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}{\left(\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}\right\}$ $Y_r=\frac{D}{2}-T_1+R_1\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-R_1\left\{\frac{\left(\frac{1}{6}\tan^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)(1-\sin\theta)+\frac{1}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\theta-\frac{2}{3}\sin^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}{\left(\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}\right\}$ $Z_t=\frac{B}{2}-R_2\frac{\left[\frac{2}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\frac{1}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\sin\theta-\frac{1}{6}\tan^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\theta-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)+\frac{2}{3}\sin\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right]}{\left(\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}$ $Z_r=\frac{T}{2}+R_1\frac{\left[\frac{2}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\frac{1}{3}\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\sin\theta-\frac{1}{6}\tan^2\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\theta-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)+\frac{2}{3}\sin\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\cos\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right]}{\left(\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)-\left(\frac{\pi}{4}-\frac{\theta}{2}\right)\right)}$  T B-t / 2 t z z D α R1 R2 Cy ey B	**Indian Standard Parallel Flange Channels** (Table 4.2)  y T 90° t D z z R1 R2 Cy ey B y

Table 15 (*Continued*)

	Exact Formula	**Approximate Formula (disregarding toe & root radius)**	**Approximate formula**
Area (A)	$A = B \times D - (D - 2T)(B - t) - 2A_t + 2A_r$	$A = B \times D - (D - 2T)(B - t)$	$A = B \times D - (D - 2T)(B - t)$
Moment of Inertia	$I_{zz}=\frac{1}{12}BD^3-\frac{1}{12}(B-t)(D-2T_2)^3+(T_1-T_2)\left(\frac{D}{2}-\frac{T_1}{3}-\frac{2T_2}{3}\right)^2-2A_t{y_t}^2+2A_r{y_r}^2$ $I_{yy}=\frac{1}{12}DB^3+BD\left(C_{zz}-\frac{B}{2}\right)^2-\frac{1}{12}(D-2T)(B-t)^3+(D-2T)(B-t)$ $\left\{C_{zz}-(B-t)\frac{[2(D-T_2)+(D-T_1)]}{[6(D-2T)]}\right\}^2-4A_t(Z_t-C_{zz})^2+4A_r(Z_r-C_{zz})^2$ $C_{zz}=\left\{\begin{matrix}\left(\frac{BD^2}{2}-(B-t)(D-2T)\left[t+\frac{(B-t)[2(D-2T_2)+(D-2T_1)]}{6(D-2T)}\right]\right)+\\ 2A_tZ_t+2A_rZ_r)\end{matrix}\right\}/A$	$I_{zz}=\frac{1}{12}BD^3-\frac{1}{12}(B-t)(D-2T_2)^3(T_1-T_2)$ $\left(\frac{D}{2}-\frac{T_1}{3}-\frac{2T_2}{3}\right)^2$ $I_{yy}=\frac{1}{12}DB^3+BD\left(C_{zz}-\frac{B}{2}\right)^2-\frac{1}{12}(D-2T)(B-t)^3$ $+(D-2T)(B-t)\left\{C_{zz}-t-\frac{(B-t)[2(D-T_2)+(D-T_1)]}{[6(D-2T)]}\right\}^2$ $C_{zz}=\left\{\begin{matrix}\frac{BD^2}{2}-(B-t)(D-2T)\\ \left[t+\frac{(B-t)[2(D-2T_2)+(D-2T_1)]}{6(D-2T)}\right]\end{matrix}\right\}/A$	$I_{zz}=\frac{1}{12}BD^3-\frac{1}{12}(B-t)(D-2T)^3$ $I_{yy}=\frac{1}{12}DB^3+BD\left(C_{zz}-\frac{B}{2}\right)^2-\frac{1}{12}$ $(D-2T)(B-t)^3+(D-2T)(B-t)$ $\left\{C_{zz}-t-\frac{(B-t)}{2}\right\}^2$ $C_{zz}=\left\{\begin{matrix}\frac{BD^2}{2}-(B-t)(D-2T)\\ \left[t+\left(\frac{B-t}{2}\right)\right]\end{matrix}\right\}/A$
Radius of Gyration	$R_{zz}=\sqrt{\frac{I_{zz}}{A}}\ ;\ R_{yy}=\sqrt{\frac{I_{yy}}{A}}$	$R_{zz}=\sqrt{\frac{I_{zz}}{A}}\ ;\ R_{yy}=\sqrt{\frac{I_{yy}}{A}}$	$R_{zz}=\sqrt{\frac{I_{zz}}{A}}\ ;\ R_{yy}=\sqrt{\frac{I_{yy}}{A}}$
Elastic Section Moduli	$Z_{zz} = 2I_{zz}/D\ ;\ Z_{yy} = I_{yy}/(B - C_{zz})$	$Z_{zz} = 2I_{zz}/D\ ;\ Z_{yy} = I_{yy}/(B - C_{zz})$	$Z_{zz} = 2I_{zz}/D\ ;\ Z_{yy} = I_{yy}/(B - C_{zz})$
Plastic Section Moduli	$Z_{Pz}=\frac{1}{4}BD^2-\frac{1}{4}(B-t)(D-2T_2)^2+(T_1-T_2)\left(\frac{D}{2}-\frac{T_1}{3}-\frac{2T_2}{3}\right)^2-2A_t\,y_t+2A_r\,y_r$ $Z_{Py}=(C_{Pz}-t)^2\left[T_2+(B-C_{Pz})\tan\theta+\frac{2}{3}(C_{Pz}-t)\tan\theta\right]+(B-C_{Pz})^2$ $[T_2+(B-C_{Pz})\tan\theta/3]+Dt(C_{Pz}-0.5t)+2A_t(0.5B+Z_t-C_{Pz})+$ $2A_r(C_{PZ}-Z_r-0.5t)$ $C_{Pz}=B-\left[\sqrt{\left(T_1^2+(0.5A+2A_t)\tan\theta\right)}-T_1)\right]/\tan\theta$	$Z_{Pz}=\frac{1}{4}BD^2-\frac{1}{4}(B-t)(D-2T_2)^2+(T_1-T_2)\left(\frac{D}{2}-\frac{T_1}{3}-\frac{2T_2}{3}\right)^2$ $Z_{Py}=(C_{Pz}-t)^2\left[T_2+(B-C_{Pz})^2\tan\theta+\frac{2}{3}(C_{Pz}-t)\tan\theta\right]$ $+(B-C_{Pz})\left[T_2+\frac{1}{3}(B-C_{Pz})\tan\theta\right]$ $+Dt\left(C_{Pz}-\frac{1}{2}t\right)$ $C_{Pz}=B-\left[\sqrt{\left(T_1^2+0.5A\tan\theta\right)}-T_1)\right]/\tan\theta$	$Z_{Pz}=\frac{1}{4}BD^2-\frac{1}{4}(B-t)(D-2T_2)^2$ $Z_{Py}=\left[(C_{Pz}-t)^2+(B-C_{pz})^2\right]$ $T+Dt\left(C_{Pz}-\frac{1}{2}t\right)$ $C_{Pz} = B - 0.25\,A/T$

Table 15 (*Concluded*)

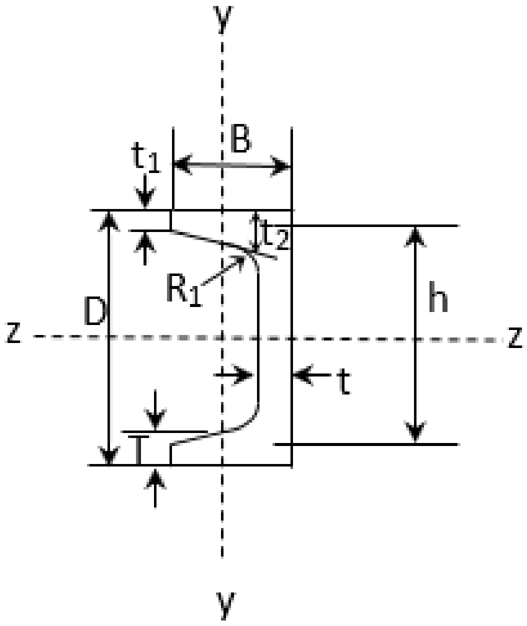
Torsional rigidity	**Approximate Formula:** $I_t = \frac{1}{6}(B-t)(t_1+t_2)(t_1^2+t_2^2)+\frac{2}{3}t\,t_2^3+\frac{1}{3}(D-2t_2)t^3+2\alpha_2\,D_2^4-4V_s\,t_1^4$ *For* 0% *flange slope,* $\alpha_2 = -0.0420+0.220\frac{t}{T}+0.136\left(\frac{R_1}{t}\right)-0.0865\left(\frac{t\,R_1}{T^2}\right)-0.0725\left(\frac{t_2}{T}\right)^2$ *For* 16 $\frac{2}{3}$ % *flange slope,* $\alpha_2 = -0.0836+0.254\left(\frac{t}{t_2}\right)+0.127\left(\frac{R_1}{t_2}\right)-0.0806\left(\frac{t\,R_1}{t_2^2}\right)-0.0858\left(\frac{t}{t_2^2}\right)^2$ *For other flange slopes the* α_2 *value may be found by linear interpolation* $S = 2 \times (m-t)/B$ $F = R_1 S\left[\left(1+S^{-2}\right)^{0.5}-1-\left(\frac{t}{2R_1}\right)\right]$ $D_2 = \frac{\left[(F+m)^2+\left(\frac{t}{R_1+t/4}\right)\right]}{(F+R_1+m)}$ $V_s = 0.105 + 0.100\,S + 0.0848\,S^2 + 0.0675\,S^3 + 0.0515\,S^4$ *For* 0% *flange slope,* $\alpha_4 = -0.0908+0.262\frac{t}{t_2}+0.123\frac{R_1}{t_2}-0.0752\frac{tR_1}{t_2^2}-0.0945\frac{t^2}{t_2^2}$ *For* 16 $\frac{2}{3}$ % *flange slope,* $\alpha_4 = -0.133+0.302\frac{t}{t_2}+0.14\frac{R_1}{t_2}-0.107\frac{tR_1}{t_2^2}-0.0956\frac{t^2}{t_2^2}$ *For other flange slopes, the value of* α_4 *may be found by linear interpolation between the above* $S = \frac{(t_2-t_1)}{(B-t)};\ H = t_2 - R_1\left[S+1-\sqrt{(S-1)}\right];\ D_4 = 2(3R_1+t+H)-\sqrt{2(2R_1+t)(2R_1+H)}$	

Table 16 Angle Sections

(*Clause* A-1)

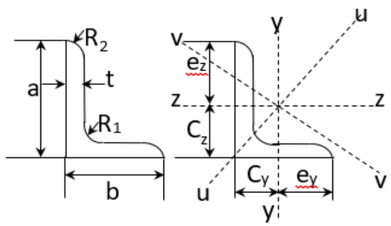
Section	$A_t = 0.215\,R_2$; $A_r = 0.215\,R_1$ $y_t = 0.229\,R_2$; $y_r = 0.229\,R_1$  R2 t a R1 b v ez z Cz y u z Cy ey v u y	
	Exact	Approximate
Area	$A = t\,(a + b - t) + A_r - 2\,A_t$	$A = t\,(a + b - t)$
Centroid	$C_y = \left[\frac{1}{2}a^2b - \frac{1}{2}(b-t)(a^2-t^2) - A_t(a+t-2y_t) + A_r(t+y_r)\right]/A$ $C_z = \left[\frac{1}{2}ab^2 - \frac{1}{2}(b^2-t^2)(a-t) - A_t(b+t-2y_t) + A_r(t+y_r)\right]/A$	$C_y = \left[\frac{1}{2}a^2b - \frac{1}{2}(b-t)(a^2-t^2)\right]/A$ $C_z = \left[\frac{1}{2}ab^2 - \frac{1}{2}(b^2-t^2)(a-t)\right]/A$
Moments of Inertia	$I_{zz} = \frac{a^3b}{12} - \frac{(b-t)(a-t)^3}{12} + ab\left(\frac{a}{2}-C_y\right)^2 - (a-t)(b-t)\left[\frac{(a+t)}{2}-C_y\right]^2 - A_t\left[(a-C_y-Y_t)^2 + (C_y+Y_t-t)^2\right] + A_r(C_y-t-Y_t)^2$ $I_{yy} = \frac{b^3a}{12} - \frac{(a-t)(b-t)^3}{12} + a\,b\left(\frac{b}{2}-C_z\right)^2 - (a-t)(b-t)\left[\frac{(b+t)}{2}-C_z\right]^2 - A_t\left[(b-C_z-Y_t)^2 + (C_z+Y_t-t)^2\right] + A_r(C_z-t-Y_r)^2$ $I_{xy} = a\,b\left(\frac{a}{2}-C_y\right)\left(\frac{b}{2}-C_z\right) - (a-t)(b-t)\left[\frac{(a+t)}{2}-C_y\right]\left[\frac{(b+t)}{2}-C_z\right] - A_t\left[(a-C_y-Y_t)(C_z+Y_t-t) + (C_y+Y_t-t)(b-C_z-Y_t)\right]$ $\alpha = \frac{1}{2}\tan^{-1}\left(\frac{2I_{xy}}{I_{xx}I_{yy}}\right)$; $I_{uu} = (I_{zz}+I_{yy})/2 + \sqrt{\left[(I_{zz}-I_{yy})^2/4 + I_{xy}^2\right]}$; $I_{vv} = \frac{I_{zz}+I_{yy}}{2} - \sqrt{\left[(I_{zz}-I_{yy})^2/4 + I_{xy}^2\right]}$	$I_{zz} = \frac{a^3b}{12} - \frac{(b-t)(a-t)^3}{12} + ab\left(\frac{a}{2}-C_y\right)^2$ $-(a-t)(b-t)\left[\frac{(a+t)}{2}-C_y\right]^2$ $I_{yy} = \frac{b^3a}{12} - \frac{(a-t)(b-t)^3}{12} +$ $a\,b\left(\frac{b}{2}-C_z\right)^2 - (a-t)(b-t)\left[\frac{(b+t)}{2}-C_z\right]^2$ $I_{xy} = a\,b\left(\frac{a}{2}-C_y\right)\left(\frac{b}{2}-C_z\right) - (a-t)(b-t)$ $\left[\frac{(a+t)}{2}-C_y\right]\left[\frac{(b+t)}{2}-C_z\right]$ $\alpha = \frac{1}{2}\tan^{-1}\left(\frac{2I_{xy}}{I_{xx}I_{yy}}\right)$ $I_{uu} = \frac{I_{zz}+I_{yy}}{2} + \sqrt{\left[\frac{(I_{zz}-I_{yy})^2}{4} + I_{xy}^2\right]}$; $I_{vv} = \frac{I_{zz}+I_{yy}}{2} - \sqrt{\left[\frac{(I_{zz}-I_{yy})^2}{4} + I_{xy}^2\right]}$

Table 16 (*Concluded*)

Radius of Gyration	$R_{zz} = \sqrt{\frac{I_{zz}}{A}}$; $R_{yy} = \sqrt{\frac{I_{yy}}{A}}$; $R_{uu} = \sqrt{\frac{I_{uu}}{A}}$; $R_{vv} = \sqrt{\frac{I_{vv}}{A}}$	$R_{zz} = \sqrt{\frac{I_{zz}}{A}}$; $R_{yy} = \sqrt{\frac{I_{yy}}{A}}$; $R_{uu} = \sqrt{\frac{I_{uu}}{A}}$; $R_{vv} = \sqrt{\frac{I_{vv}}{A}}$
Elastic Section Moduli	$Z_{zz} = I_{zz}/(a - C_y)$; $Z_{yy} = I_{yy}/(b - C_z)$	$Z_{zz} = I_{zz}/(a - C_y)$; $Z_{yy} = I_{yy}/(b - C_z)$
Plastic Section Moduli	$I_{Pz} = t(b-t)\left[a - \frac{(A/2 - 2A_t)}{t} - \frac{t}{2}\right] + \frac{t}{2}\left[a^2 + \left(\frac{(A - 2A_t)}{t}\right)^2 - a\left(\frac{(A-2A_t)}{t}\right)\right] - A_t(a-t) + A_r\left[a - \frac{(A/2-2A_t)}{t} - t - Y_r\right]$ $I_{Py} = t(a-t)\left[b - \frac{(A/2 - 2A_t)}{t} - \frac{t}{2}\right] + \frac{t}{2}\left[b^2 + \left(\frac{(A - 2A_t)}{t}\right)^2 - b\left(\frac{(A-2A_t)}{t}\right)\right] - A_t(b-t) + A_r\left[b - \frac{(A/2-2A_t)}{t} - t - Z_r\right]$	$I_{Pz} = t(b-t)\left[a - \frac{A}{2t} - \frac{t}{2}\right] + \frac{t}{2}\left[a^2 + \left(\frac{A}{t}\right)^2 - a\left(\frac{A}{t}\right)\right]$ $I_{Py} = t(a-t)\left[b - \frac{A}{2t} - \frac{t}{2}\right] + \frac{t}{2}\left[b^2 + \left(\frac{A}{t}\right)^2 - b\left(\frac{A}{t}\right)\right]$
Torsional rigidity	------	$I_t = \frac{bt^3}{3} + \frac{(a-t)t^3}{3}$

A-2 GENERAL PROCEDURE FOR THE CALCULATION OF TORSIONAL CONSTANTS I_T AND I_W FOR ANY GENERAL OPEN CROSS SECTION

Referring to the generic open cross section and notation shown in Figure 3, the torsional properties I_t ad I_w may be expressed as follows:

$$I_t = \frac{1}{3}\int_0^b t^3 \, ds$$

Calculation of I_w is shown in the following steps. For the detailed procedure, consult specialized literature.

$$W_{ns} = \frac{1}{A}\int_0^b W_{os} t ds - W_{os}$$

where

$$A = \int_0^b t \, ds$$

$$W_{os} = \int_0^s \rho_0 ds$$

$$S_{ws} = \int_0^s t \, ds$$

using these parameters I_w can be calculated as

$$I_w = \int_0^b W_{ns}^2 t ds$$

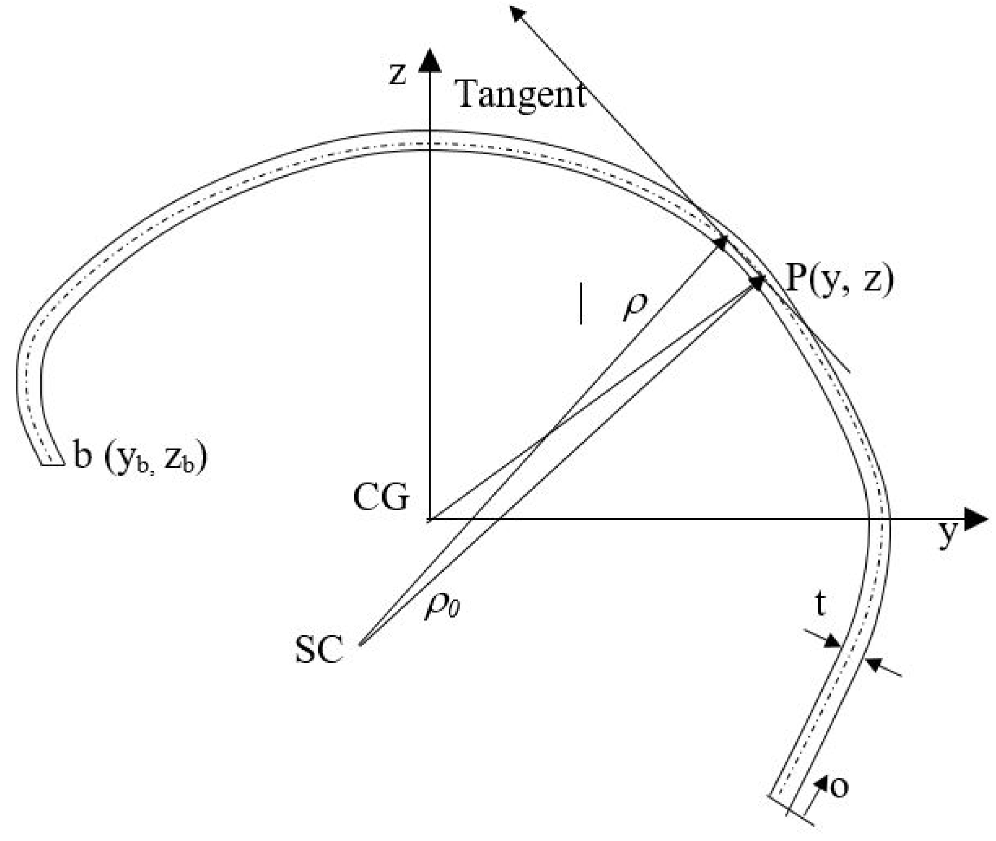


FIG. 3 GENERAL CROSS SECTION

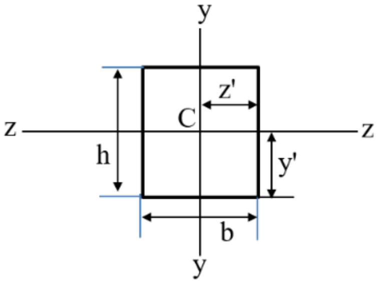
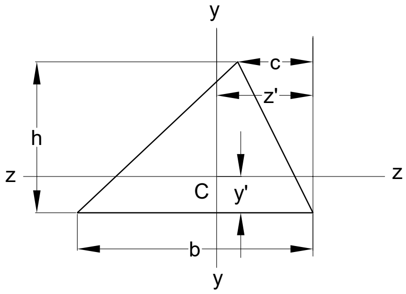
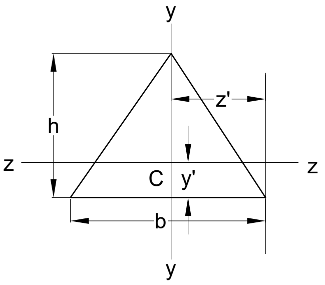
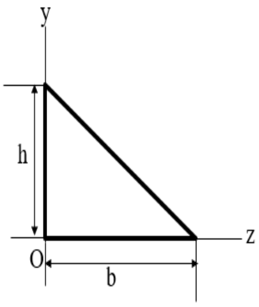
ANNEX B

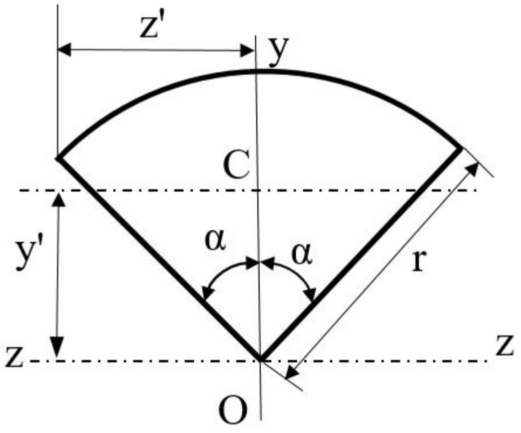
(*Clause* 9.2)

METHODS TO CALCULATE THE EXACT GEOMETRICAL SECTIONAL PROPERTIES USING COMPONENT METHOD

B-1 GENERAL

B-1.1 The entire section is discretized into rectangles, triangles and sectors. The area, moment of inertia, centroidal distances etc for rectangle, triangle and sector are given below.

Shape of the cross-section element	Sectional properties about its own centroidal axes
1. Rectangle (origin of axes at centroid)  	$A = bh$ $z' = \frac{b}{2}$ $y' = \frac{d}{2}$ $I_{zz} = \frac{bh^3}{12}$ $I_{yy} = \frac{hb^3}{12}$ $I_{zy} = 0$
2. Triangle (origin of axes at centroid)  	$A = \frac{bh}{2}$ $z' = \frac{b+c}{3}$ $y' = \frac{h}{3}$ $I_{zz} = \frac{bh^3}{36}$ $I_{yy} = \frac{hb}{36}\left(b^2 - bc + c^2\right)$ $I_{zy} = \frac{bh^2}{72}\left(b - 2c\right)$
3. Isosceles triangle (origin of axes at centroid)  	$A = \frac{bh}{2}$ $z' = \frac{b}{2}$ $y' = \frac{h}{3}$ $I_{zz} = \frac{bh^3}{36}$ $I_{yy} = \frac{hb^3}{48}$ $I_{zy} = 0$
4. Right triangle (origin of axes at vertex)  	$A = \frac{bh}{2}$ $z' = \frac{b}{3}$ $y' = \frac{h}{3}$ $I_{zz} = \frac{bh^3}{12}$ $I_{yy} = \frac{hb^3}{12}$ $I_{zy} = \frac{b^2h^2}{24}$

5. Circular sector (Origin of axes at centre of circle)  	α = angle in radians $\left(\alpha \le \frac{\pi}{2}\right)$ $A = \alpha r^2 \qquad z' = r\sin(\alpha) \qquad y' = \frac{2r\sin(\alpha)}{3\alpha}$ $I_{zz} = \frac{r^4}{4}\left(\alpha + \sin(\alpha)\cos(\alpha)\right)$ $I_{yy} = \frac{r^4}{4}\left(\alpha - \sin(\alpha)\cos(\alpha)\right)$ $I_{zy} = 0$
Where A = Area; z' and y' = Distances to centroid C; I_{zz}, I_{yy} = moments of inertia with respect to the z and y axes, respectively, and I_{zy} = Product of inertia with respect to the z and y axes	

B-1.2 Discretization of the I-Section

The section properties of I section can be obtained by algebraic addition of different groups shown in Fig. 4 as IG1 – IG2 + IG3. The components of properties of IG1, IG2 and IG3 is given in **B-1.1**

B-1.3 Discretization of the Channel Section

The section properties of the channel section can be obtained by algebraic addition of different groups shown in Fig. 5 as CG1 – CG2 + CG3. The components of properties of CG1, CG2 and CG3 is given in **B-1.1**.

B-1.4 Discretization of the Angle Section

The section properties of I-section can be obtained by algebraic addition of different groups shown in Fig. 6 as AG1 – AG2 + AG3. The components of properties of AG1, AG2 and AG3 is given in **B-1.1**.

B-2 SECTIONAL PROPERTIES OF GROSS SECTION

B-2.1 The entire section is discretized into elements, and the sectional properties of these elements could be calculated using **B-1.1**. The section properties of the whole section, could be obtained by using scalar additions, and rotational transformations appropriately.

Total area, $A = \sum_{i=1}^{n} A_i$; where i is the element number, and n is the number of elements.

Centroidal distance of the gross section, $\bar{z} = \frac{\Sigma A_i z_i}{A}\ \bar{y} = \frac{\Sigma A_i y_i}{A}$; where z_i , y_i , $\bar{z}$ and $\bar{y}$ are measured from the same set of z-y axes.

B-2.2 Theorem for Translation or Shifting of Axes

If $I_{xx,i}$ and $I_{yy,i}$ are the moments of inertia of the i^{th} element at its own centroidal axes, they should be shifted to the centroidal axes of the gross section using parallel axes theorem:

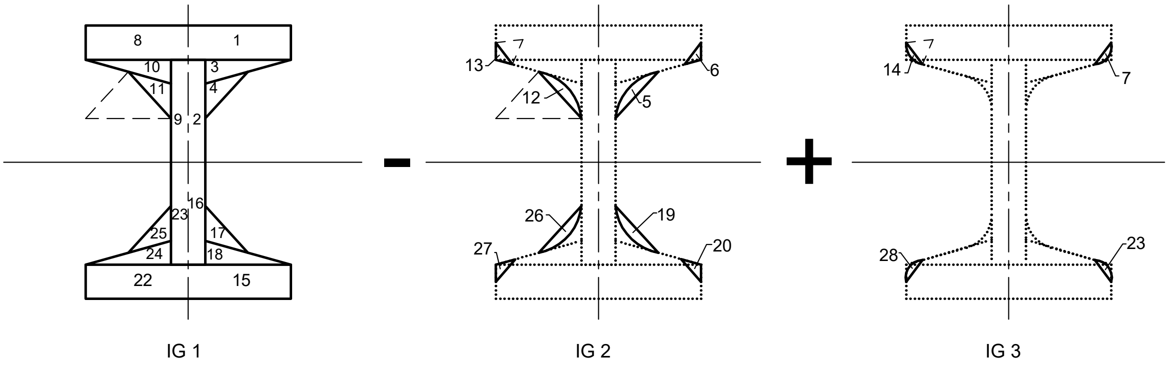


Fig. 4 I – Section Components

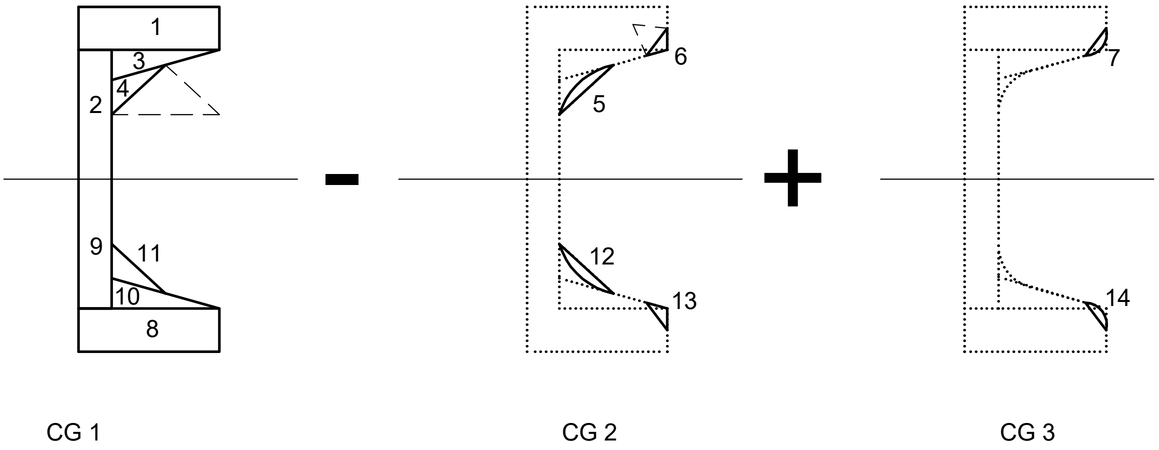


Fig. 5 Channel Section Components

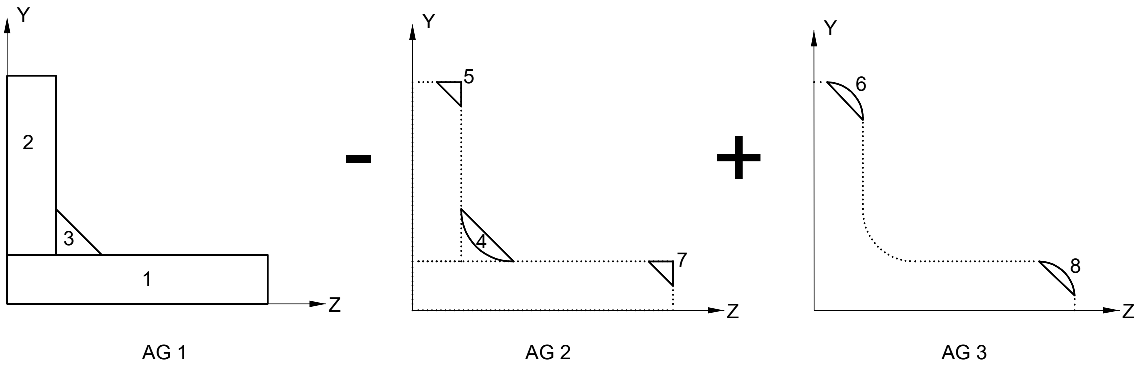


Fig. 6 Angle Section Components

$$I_{\bar{z}\bar{z},\mathrm{i}} = I_{\mathrm{zz,\,i}} + A_{\mathrm{i}}\left(y_{\mathrm{i}} - \bar{y}\right)^2 \qquad I_{\bar{y}\bar{y},\mathrm{i}} = I_{yy,\mathrm{i}} + A_{\mathrm{i}}\left(z_{\mathrm{i}} - \bar{z}\right)^2 \qquad I_{\bar{z}\bar{y},\mathrm{i}} = I_{zy,\mathrm{i}} + A_{i}\left(z_{\mathrm{i}} - \bar{z}\right)\left(y_{\mathrm{i}} - \bar{y}\right)$$

$$I_{\bar{z}\bar{z},\,gross} = \sum\left(I_{\bar{z}\bar{z},\mathrm{i}}\right) \qquad I_{\bar{y}\bar{y},\,gross} = \sum\left(I_{\bar{y}\bar{y},\mathrm{i}}\right) \qquad I_{\bar{z}\bar{y},\,gross}\sum\left(I_{\bar{z}\bar{y},\mathrm{i}}\right)$$

B-2.3 Tensor Transformations for Rotation of Axes

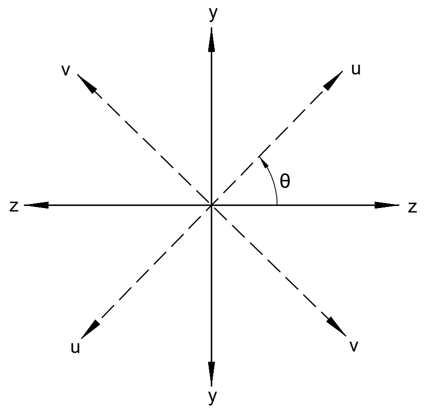


Fig 7 Rotation of Axes

If moments of inertia of the element centroidal axes, needs to be rotated to make it parallel to the section centroidal axes, transformation formulae given below could be used (*see* Fig. 7).

$$I_{\mathrm{uu}} = \frac{I_{\mathrm{zz}} + I_{\mathrm{yy}}}{2} + \frac{I_{\mathrm{zz}} - I_{\mathrm{yy}}}{2}\cos\,(2\theta) + I_{\mathrm{zy}}\sin\left(2\theta\right)$$

$$I_{\mathrm{vv}} = \frac{I_{\mathrm{zz}} + I_{\mathrm{yy}}}{2} + \frac{I_{\mathrm{zz}} - I_{\mathrm{yy}}}{2}\cos\left(2\left(\theta + \frac{\pi}{2}\right)\right) + I_{zy}\sin\left(2\left(\theta + \frac{\pi}{2}\right)\right)$$

$$I_{\mathrm{uv}} = \frac{I_{\mathrm{zz}} - I_{\mathrm{yy}}}{2}\sin\left(2\theta\right) - I_{\mathrm{zy}}\cos\,(2\theta)$$

Where I_{zz}, I_{yy} the moments of inertia about the initial axes and I_{zy} the product of inertia. I_{uu}, I_{vv} and I_{uv} are the respective quantities for the rotated axes u, v.

The product of inertia I_{zy} is zero, when z or y are symmetry axes. θ is measured counter-clockwise.

For angle sections, the I_{zz}, I_{yy} axes will not be the principal axes. Principal axes u-u and v-v will make an angle ϕ with the z-y axes, given by:

$$\tan(2\phi) = \frac{2I_{zy}}{I_{zz} - I_{yy}}$$

$$I_{uu}, I_{vv} = \frac{I_{zz} + I_{yy}}{2} \pm \sqrt{\left(\frac{I_{zz} - I_{yy}}{2}\right)^2 + I_{zy}{}^2}$$

$$r_z = \sqrt{\frac{I_{zz}}{A}} \quad r_y = \sqrt{\frac{I_{yy}}{A}} \quad r_u = \sqrt{\frac{I_{uu}}{A}} \quad r_v = \sqrt{\frac{I_{vv}}{A}}$$

Thus, the radii of gyration in all the directions can be obtained.

B-2.4 Plastic Section Moduli

Determination of plastic section moduli needs identification of equal area axis. When the section becomes plastic, the cross section will be subjected to uniform stress which is equal to its yield stress. Since compressive force is equal to tensile force, equal area axis divides the section into two equal halves.

If the section is bi-symmetric (for example, I section), then equal area axis and elastic neutral axis coincides.

$$Z_{pz} = \frac{A}{2}\left(y_c + y_t\right) \qquad Z_{py} = \frac{A}{2}\left(z_c + z_t\right)$$

where y_c, z_c are the distances of centroid of area in compression, from corresponding plastic neutral axis; and y_t, z_t are the distances of centroid of area in tension, from corresponding plastic neutral axis. A is the area of the whole section.

Channel sections are mono-symmetric, (symmetric about z axis, and unsymmetric about y axis), hence plastic neutral axis in z direction is same as that of elastic neutral axis. Vertical equal area axis will be different from that of vertical elastic neutral axis. Hence, it should be determined separately.

$$Z_{pz} = \frac{A}{2}\left(y_c + y_t\right) \qquad Z_{py} = \frac{A}{2}\left(z_c + z_t\right)$$

where y_c, z_c are the distances of centroid of area in compression, from corresponding plastic neutral axis, and y_t, z_t are the distances of centroid of area in tension, from corresponding plastic neutral axis.

To find y_c and y_t,

$$y_c = \frac{\sum\left(A_i y_i\right)}{\frac{A}{2}} \qquad y_t = \frac{\sum\left(A_j y_j\right)}{\frac{A}{2}}$$

To find z_c and z_t,

$$z_c = \frac{\sum\left(A_i z_i\right)}{\frac{A}{2}} \qquad z_t = \frac{\sum\left(A_j z_j\right)}{\frac{A}{2}}$$

i denotes elements in compression, j denotes elements in tension

For an ith element, A_i is the area of the element, and y_i is the distance from element centroid to horizontal equal area axis, and z_i is the distance from element centroid to vertical equal area axis.

B-2.5 Determination of Vertical Equal Area Axis

On either sides of equal area axis, area = $A/2$. Since the section is monosymmetric, the area of each shaded region = $A/4$. The first step to the determination of Z_{py} is the determination of distance of vertical equal area axis from the toe of the flange, which is denoted as

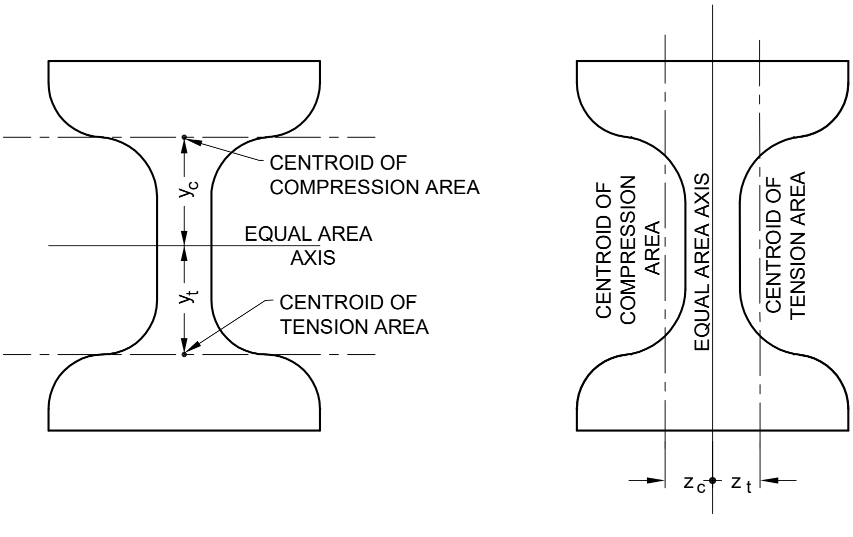


FIG. 8 BI-SYMMETRIC I-SECTION

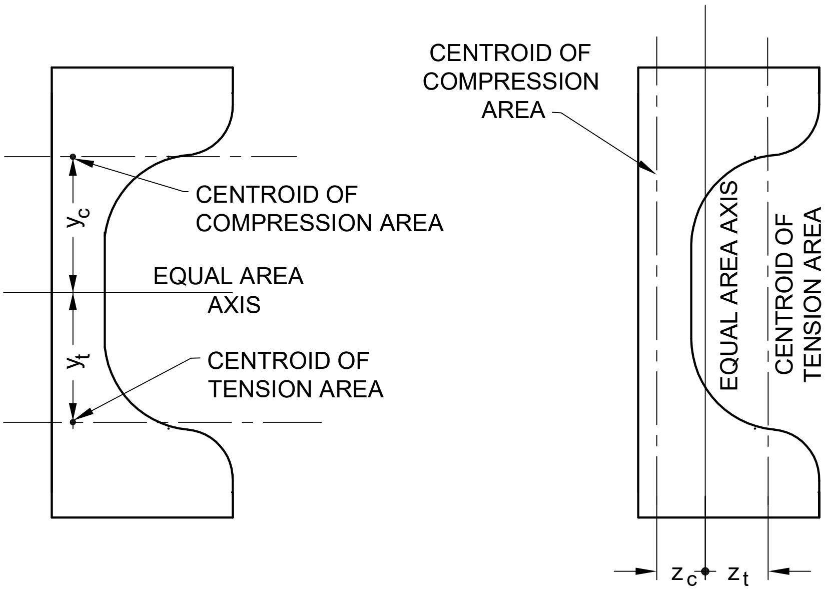


FIG. 9 MONO SYMMETRIC CHANNEL SECTION

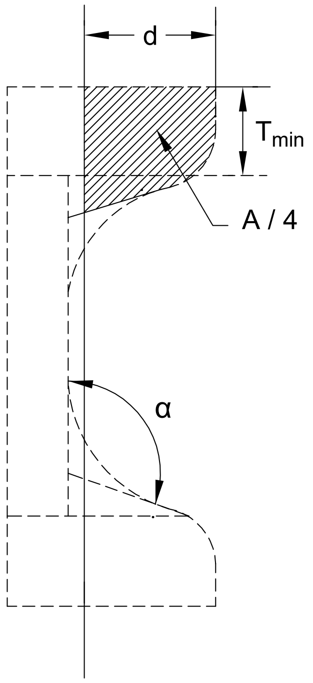


FIG. 10 SECTION DETERMINATION OF VERTICAL PLASTIC NEUTRAL AXIS OF CHANNEL

d_p. Referring to the element numbering given before for channel sections, this shaded region consists of some portion of element 1, some parts of element 3, and the whole area of element 7, deducting the area of element 6 (as given in equation below). The effect of root is ignored here.

$$\left(d_{\mathrm{p}} \times T_{\min}\right)+\left(\frac{1}{2} \times d_{\mathrm{p}} \times d_{\mathrm{p}} \tan \left(\alpha-\frac{\pi}{2}\right)\right)+ Area\ \ of\ element\ 7 - Area\ \ of\ element\ 6=\frac{A}{4}$$

Where, T_{min} is the width of flange at the toe (width of element 1), and α is the flange angle.

The above equation is quadratic in d_p, and is of the form $ad_{\mathrm{p}}^2+bd_{\mathrm{p}}+c=0$, which yields two solutions, out of which one is appropriate. Once d_{p} is identified, z_{py} could be found.

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

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